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Annotated checklist and biodiversity analysis of benthic fauna at Sylt Outer Reef and Borkum Reef Ground (North Sea)

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Abstract

Benthic fauna caught by ring dredge and 2 m beam trawl at the NATURA 2000 Sylt Outer Reef (SAR) and Borkum Reef Ground (BRG) sites in the North Sea are examined in relation to the intensity of mobile bottom-trawling fisheries. Samples were taken from 33 stations in the two areas, and the collected benthic fauna, consisting of infauna, epifauna, and demersal fish was determined. A total of 123 species were found, consisting of the phyla Chordata, Mollusca, Arthropoda, Echinodermata, Annelida, Cnidaria, and Bryozoa, with Chordata and Mollusca being the most species-rich phyla. The species compositions of BRG and SAR are relatively clearly separated. There was greater species diversity at BRG, likely due to lower fishing pressure from mobile bottom trawling than at SAR. Long-term data acquisition and analysis will be needed to visualize past and future changes in biodiversity.

Keywords

Beam trawl, benthic fauna, fishery impact, MGF Nordsee, ring dredge, species composition

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Introduction

The North Sea is considered one of the best studied marine ecosystems of all fauna (Wieking and Kröncke 2003). A comprehensive data coverage of the North Sea is already available for the epifauna (Zühlke et al. 2001; Callaway et al. 2002; Neumann et al. 2009, 2017), while the infauna has also been surveyed throughout the North Sea in recent years (Künitzer et al. 1992; Reiss et al. 2010; Kröncke et al. 2011). Nevertheless, a regular inventory of the presence of the in- and epifauna and demersal fishes over time is important for the visualization of changes in species abundance, especially in times of rapid climate change (Rumohr and Kujawski 2000; Zettler et al. 2018). Infauna are those species such as Polychaeta that live in the sediment layers (Dobson and Frid 1998), while species that live and crawl on the surface of the seafloor such as crabs are defined as epifauna (Trannum et al. 2019). Demersal fishes, for example flatfishes, which are found on the bottom or just above it also belongs to the benthic fauna (Reiss et al. 2010).

Sublittoral zones provide an important ecological

niche in the North Sea, which is characterized by tidal flats, serving as breeding grounds for marine species (Papenmeier and Hass 2018). Fishes comprise a large fraction of the epifauna of the North Sea and are thus important for food webs and are subject to the impact of fishing and climate (Heath 2005). Polychaetes also form a large part of the soft-bottom epibenthic macrofauna and serve as food for many other marine species at higher trophic levels (Buruaem et al. 2015). The benthic fauna of the North Sea, along with that of the western Baltic Sea, is considered to be most exposed to trawl-fishing activity (Mazor et al. 2020; Nachtsheim et al. 2021) being considered to be the greatest anthropogenic influence of marine ecosystems (Dayton et al. 1995; Herr et al. 2009; Couce et al. 2020). Dredging invasively touches and alters large portions of sediment, destroys structures (e.g. sediment mounds and gravel fields with sedentary animals) and removes sediment including the in- and epifauna (Buruaem et al. 2015). The negative effect of bottom fishing was already studied several decades ago (Philippart 1998). Additional anthropogenic influences such as pollution, eutrophication, construction activities (Rijnsdorp et al. 1996), or microplastic pollution (Rummel et al. 2015), have altered the marine realm, in part, for several hundred years already (Robinson and Frid 2008). In addition to anthropogenic influences, as in any ecosystem, there are also biotic factors such as the annual plankton dynamics in the North Sea (Sapp et al. 2007) that have an influence on the occurrence of benthic organisms.

The presence of a high biodiversity is important for the ecological health of the North Sea (Clare et al. 2015), and especially the bottom-dwelling organisms represent an important ecological group (Robinson and Frid 2008), but marine biodiversity is endangered by the impact of fisheries (Rumohr and Kujawski 2000). Hence, one goal of the first DAM (Deutsche Allianz für Meeresforschung) pilot mission "MGF Nordsee" (Mobile Grundberührende Fischerei), which started in 2020, is to evaluate the impact of bottom-trawling fisheries in the NATURA 2000 MPA's (marine protected areas) SAR, BRG and Dogger Bank (DOG) in the German EEZ (Exclusive Economic Zone), which should be excluded from mobile bottom-trawling fishery in the near future.

In order to carry out a future BACI (before-after-control-impact) study, data collection of the abundances of endo- and epifaunal communities started at two of three NATURA 2000 sites (BRG and SAR) in order to assess the present status of biodiversity and species richness in these communities, and a net of sample sites with their location already oriented on different fishing gradients in the two areas. We intend to provide a general faunal assessment under the influence of the bottom-trawling fishery in future exclusion areas in order to provide a better understanding of benthic fauna–environment interactions, regional fishing effects, recolonization potential, and population dynamics.

In this study, a high-quality description of the present macrozoobenthic status in the two NATURA 2000 sites including some stations at reference areas outside the MPAs is provided.

Study Area

The two selected areas (SAR and BRG) in the North Sea are part of the European network of protected areas as two of 10 NATURA 2000 protected areas and are therefore subject to special requirements such as the Fauna-Flora-Habitat Directive (FFH Directive) with regard to economic use (Fig. 1). The study sites include focus areas (Fig. 1, red polygons), where the overall project "MGF Nordsee" is conducting targeted investigations to collect data as comprehensively as possible. The stations were chosen according to the focus areas and selected according to fishing intensity gradients and historical datasets. This resulted in a different number of stations being sampled in the two study areas, as the focus areas from the "MGF North Sea" project were of different sizes.

Sylt Outer Reef. The SAR (area center: 54°55′N, 007°20′E) covers an area of 5.603 km^2 in the eastern German Bight, west of the North Frisian island of Sylt (Fig. 1B). Here, coarse sand, medium sand areas, and reef structures alternate in water depths of 48–8 m and enable a high diversity of benthic fauna. These reef structures are unique for the North Sea and are therefore especially protected. Although protected, the area is economically exploited by fishing, offshore wind farms, global shipping, and mining sand and gravel (BfN[1] 2020).

Borkum Reef Ground. The BRG (Fig. 1) is characterized primarily by sandy sediment and extends over 625 km^2 and is located at the southern North Sea, northwest of the East Frisian Wadden Sea island Borkum. The sediment is interspersed with gravel, coarse sand, shingle beds and few reef-like structures between depths of 33–18 m, supporting increased habitat and structural diversity. The area is subject to the so-called stepping-stone concept (Packmor and Riedl 2016) and is thus a connecting link between other protected areas, allowing, for example, a migration corridor for benthos species. Economic use of the area also is global shipping, offshore wind farms and bottom-trawling fisheries (BfN[2] 2020).

Methods

The study sites were approached with the research cutter F.K. *Senckenberg* in May (SAR) and July (BRG) 2020. At BRG, 14 stations and at SAR 19 stations were sampled (Appendix Table A1). Care was taken to ensure that the stations were chosen to avoid to influence or even destroy sensitive reef structures by invasive sampling. This was ensured by studying existing sidescan sonar images of the seafloor and determining the route accordingly in advance.

At each station, water temperature and salinity were

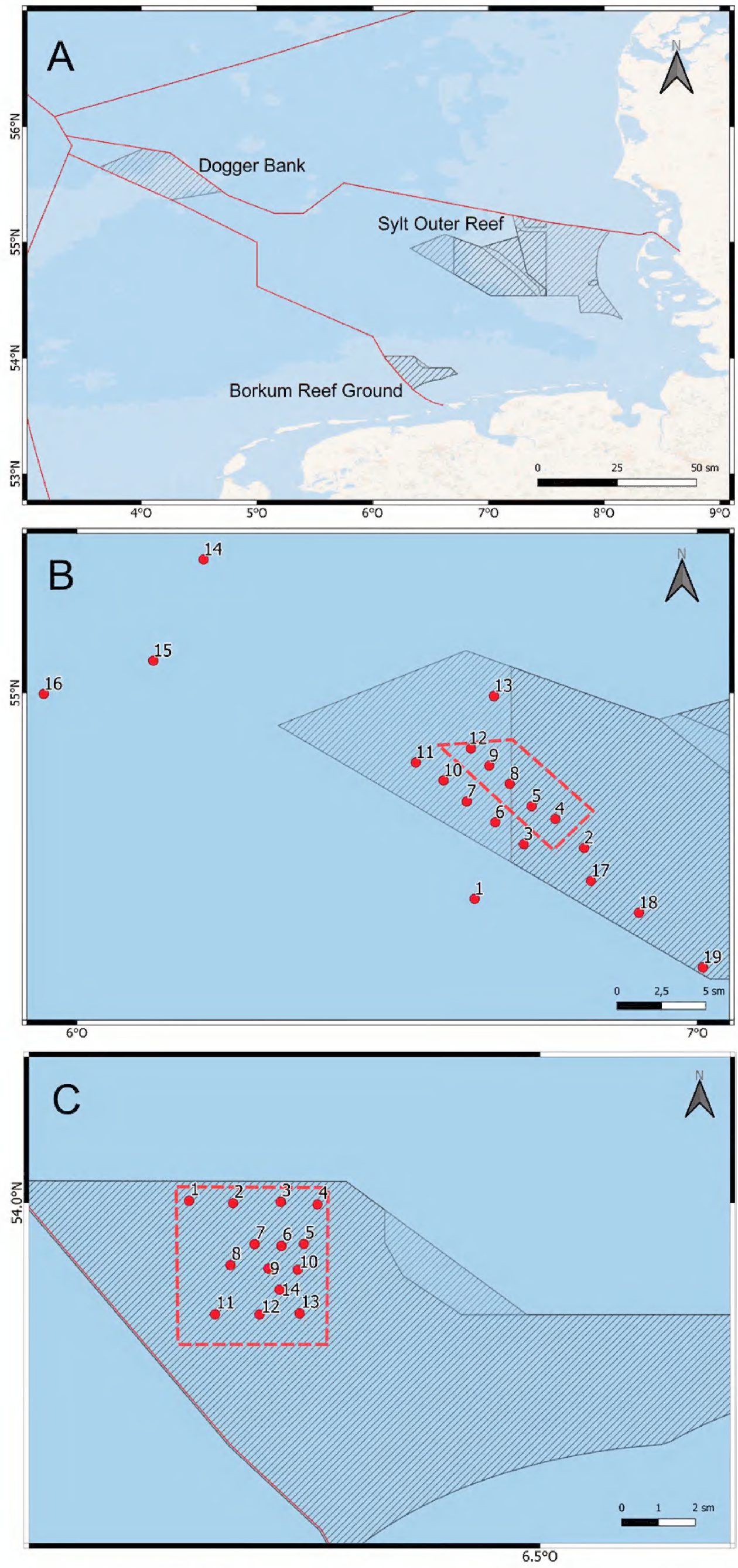


Figure 1. A. Map of North Sea showing NATURA 2000 protected areas indicated by shaded polygons, Sylt Outer Reef and Borkum Reef Ground are the research areas being in the focus of this publication, red lines mark the border of the exclusive economic zone. **B.** Map of study site SAR and sampling stations of new records, red polygon marks the focus area. **C.** Map of study site BRG and sampling stations of new records, red polygon marks the focus area. Stations where samples were taken are marked with a red dot, table with coordinates in Appendix Table A1.

measured with a wireless CTD (conductivity, temperature, depth) probe Sea and Sun technologies, lowering the probe to the seabed and then slowly raising it again while recording (e.g. Zatsepin et al. 2010). Subsequently, a ring dredge (diameter 1 m, mesh size 1 cm^2) was used to sample the main taxa of the epi- and endobenthos (e.g. Rees 2009). For this purpose, the dredge was lowered to the seafloor and pulled slowly in one direction by the ship for about 3–5 minutes, depending on the expected sediment. The ring dredge intruded up to 50 cm into the seafloor and thus allowed the determination of the main in- and epifaunal elements. After sorting the samples and determining the species, they were recorded in a presence/absence matrix and the animals were released back into their natural habitat if possible. Species which could not be determined on board were fixed in 96% EtOH and were brought to the home lab for later identification. In addition, the epifauna was sampled using a 2 m beam trawl (rump mesh size 1 cm^2), which is a verified method to capture epifauna (e.g. Zühlke et al. 2001). The beam trawl was towed over a distance of one nautical mile (nm = 1.85 km) at a speed of approximately 2 knots. After photographic documentation of the sample, the fine fraction (>1 mm) was separated, the catch volume was determined and the upper sieve fraction (>1 cm) was sorted, while all species were determined on board and recorded by their abundance (if non-colonial forms). Undetermined species, species of scientific interest and the fine fractions of the epifaunal samples were fixed in 96% EtOH for subsequent lab determinations and analyses and were later added to the diversity dataset already obtained on board. Most of the species determined at the lab were afterwards catalogued in our collections, being searchable via the catalogue portal AQUILA (https://search.senckenberg.de/aquila-public-search/search). Voucher numbers have not yet been assigned. Sex, in species where sexes are separate, were not determined. Since the captured species were mostly released directly back into the wild, it was not possible to take detailed pictures. Therefore, the images of the species are only

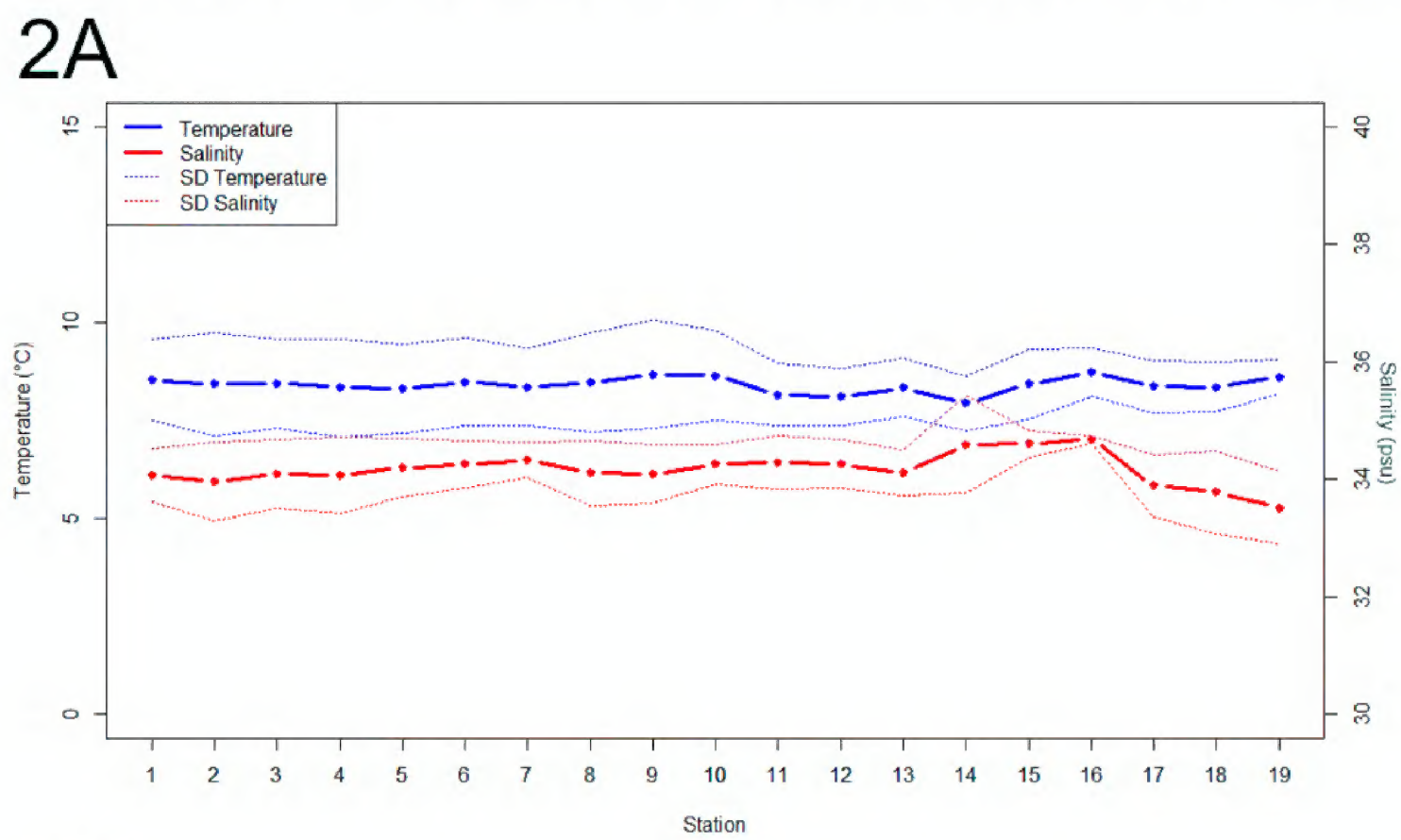


Figure 2. Mean temperature (°C, blue line) and salinity (psu, red line) from all stations of **A.** SAR and **B.** BRG with standard deviation (dotted lines).

exemplary and do not show the original captured species.

All statistical analyses were conducted using R (v. 4.0.3, 2020) and the packages *vegan* (v. 2.5-7), *CommEcol* (version 1.7.1) and *car* (v. 3.0-10). For the evaluation of the Shannon-Wiener index, first a Levene test was performed to investigate the homogeneity of the species found. In the second step, a Two Sample *t*-test was applied to detect significant differences in species abundances in the two study areas. Multivariate statistics were used to perform a similarity analysis after Bray and Curtis (1957).

Results

Water parameters. An evaluation of the water parameters of the study sites with respect to temperature and salinity (Fig. 2) showed that mean water temperature and salinity did not show any great variation between the stations of SAR and BRG, respectively. The mean temperature of all stations measured in the SAR was 8.4 °C, the mean salinity 34.2 psu (Fig. 2A). In BRG the mean temperature was 15.9 °C, the mean salinity 33.3 psu (Fig. 2B). The difference in temperature between SAR and BRG was caused by different sampling seasons (SAR = May; BRG = June). The salinity in BRG is on average about 1 ‰ below the salinity from SAR as this area is situated closer to the coast and to freshwater influx.

Presence of species. The following tabular overview shows the abundances of species sorted by phylum found in the areas during sampling with the fishing method and their endangerment status according to the German Red List Centre (https://www.rote-liste-zentrum.de/index.html) (Tables 1, 2).

New records. In the study sites SAR and BRG, a total of 82 species of 59 different families, belonging to seven phyla were collected and identified at a total of 33 stations. Almost all species were identified on board immediately after capture and released back into the water. Only a few specimens were taken to the laboratory for post-determination (described in methods). In the following annotated listing of all fully determined species, identification information was taken from Marine Species Identification Portal (http://species-identification.org) verbatim.

Phylum Annelida
Family Aphroditidae

***Aphrodita aculeata* Linnaeus, 1758**
Figure 3A

New records. GERMANY – **North Sea** • SAR; 54° 44.12′N, 006°49.76′E; 41.2 m depth (dp.); 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.544N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Elliptical body with overlapping scales, occurance on segments 1, 3, 4, 6, 29 and 30. First two pairs of scales are round.

Family Capitellidae

***Notomastus latericeus* Sars, 1851**

New records. GERMANY – **North Sea** • BRG; 54° 00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53° 57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Two groups of small eyes, body very fragile. Hooded hooks at posterior body. Thorax with 12 segments with a reticulated integument.

Family Glyceridae

***Glycera lapidum* Quatrefages, 1866**
Figure 3B

New records. GERMANY – **North Sea** • SAR; 55° 12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Anteriorly broad body, tapering posteriorly, 170 segments. Notopodial much shorter than the neuropodial. Two kinds of papillae at pharynx, tall and oval ones.

Family Nephtyidae

***Nephtys caeca* (Fabricius, 1780)**

New records. GERMANY – **North Sea** • SAR; 54° 44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54° 47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54° 59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • BRG; 54° 00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Strong body with 150 segments. Pentagonal rounded protostomium. Outwards curved gills, starting at segment 4 to the posterior end.

***Nephtys hombergii* Savigny in Lamarck, 1818**
Figure 3C

New records. GERMANY – **North Sea** • SAR; 54° 59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • BRG; 54°

Table 1. Species presence/absence at SAR with fishing method (RD = ring dredge, BT = beam trawl) and endangerment status (1 = threatened by extinction, 2 = critically endangered, 3 = endangered, G = endangerment of unknown extent, R = extremely rare, D = data insufficient, * = less vulnerable, ne = not established). Sorted by phylum and by occurrence (species threatened with extinction are ranked first within the phylum, regardless of occurrence).

Taxon	Station																			Fishing method	Status
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
Annelida																					
Aphrodita aculeata Linnaeus, 1758		●	●	●	●	●	●	●	●	●	●	●		●	●			●	●	RD, BT	D
Nephtys caeca (Fabricius, 1780)		●				●		●					●							RD	*
Nephtys incisa Malmgren, 1865									●		●						●			RD	*
Nephtys hombergii Savigny in Lamarck, 1818													●			●				RD	*
Nephthys spp.		●			●	●							●		●	●				RD	
Glycera lapidum Quatrefages, 1866														●						RD	D
| Capitellidae indet.					●															RD	
| Spionidae indet.												●								RD	
| Opheliidae indet.													●							RD	
| Polynoidae indet.															●					RD	
Arthropoda																					
Corystes cassivelaunus (Pennant, 1777)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	*
Pagurus bernhardus (Linnaeus, 1758)	●		●		●		●					●	●	●		●	●	●	●	RD, BT	*
Liocarcinus holsatus (Fabricius, 1798)		●			●								●	●				●		RD, BT	*
Upogebia deltaura (Leach, 1816)											●			●	●					RD, BT	G
Goneplax rhomboides (Linnaeus, 1758)														●	●					RD, BT	R
Crangon allmanni Kinahan, 1860													●							BT	*
Eurydice pulchra Leach, 1815											●									RD	*
Liocarcinus depurator (Linnaeus, 1758)																			●	RD	*
Nephrops norvegicus (Linnaeus, 1758)														●						BT	G
Pisidia longicornis (Linnaeus, 1767)							●													BT	*
Processa nouveli holthuisi Al-Adhub & Williamson, 1975														●						RD	*
Thia scutellata (Fabricius, 1793)													●							RD	D
Callianassa subterranea (Montagu, 1808)														●						RD	*
Bryozoa																					
Electra pilosa (Linnaeus, 1767)				●		●		●			●	●			●	●		●	●	RD, BT	*
Chordata																					
Raja clavata Linnaeus, 1758											●									BT	1
Buglossidium luteum (Risso, 1810)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	*
Arnoglossus laterna (Walbaum, 1792)	●	●	●	●	●		●	●	●	●	●	●	●	●	●			●	●	BT	*
Callionymus lyra Linnaeus, 1758	●	●	●		●	●	●	●	●	●	●	●	●	●	●				●	RD, BT	*
Limanda limanda (Linnaeus, 1758)		●	●	●	●	●	●	●	●	●	●	●		●	●			●	●	RD, BT	*
Pleuronectes platessa Linnaeus, 1758		●	●	●	●	●	●	●	●	●	●	●		●				●	●	BT	*
Agonus cataphractus (Linnaeus, 1758)								●		●					●				●	BT	*
Merlangius merlangus (Linnaeus, 1758)					●									●	●				●	BT	*
Eutrigla gurnardus (Linnaeus, 1758)	●							●						●						BT	*
Hippoglossoides platessoides (Fabricius, 1780)							●							●						BT	*
Ammodytes sp.													●							RD, BT	
Clupea harengus Linnaeus, 1758			●																	RD	*
Hyperoplus lanceolatus (Le Sauvage, 1824)													●							RD, BT	D
Microstomus kitt (Walbaum, 1792)					●															BT	*
Ascidiella scabra (Müller, 1776)													●							BT	R
Cnidaria																					
Epizoanthus papillosus Johnston, 1842								●							●			●		BT	
Obelia longissima (Pallas, 1766)									●		●									BT	D
Obelia geniculata (Linnaeus, 1758)				●																BT	D
| Hexacorallia indet.						●														RD	
| Actiniaria indet.									●		●									RD	
| Caryophylliidae indet.												●								RD	
Echinodermata																					
Spatangus purpureus O.F. Müller, 1776													●							RD	1
Asterias rubens Linnaeus, 1758	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	*
Astropecten irregularis (Pennant, 1777)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	G

Taxon	Station																			Fishing method	Status
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
Echinocardium cordatum (Pennant, 1777)	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	RD, BT	*
Ophiura ophiura (Linnaeus, 1758)	●	●	●	●	●	●	●	●	●	●		●			●			●	●	RD, BT	*
Paraleptopentacta elongata (Düben & Koren, 1846)					●	●	●	●	●	●	●	●			●					RD	G
Brissopsis lyrifera (Forbes, 1841)														●	●					RD, BT	G
Amphiura chiajei Forbes, 1843														●						RD	R
Mollusca																					
Chamelea striatula (da Costa, 1778)	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	RD, BT	ne
Turritellinella tricarinata (Brocchi, 1814)	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	RD, BT	G
Phaxas pellucidus (Pennant, 1777)	●	●	●	●	●	●	●	●	●	●						●	●	●	●	RD, BT	*
Aporrhais pespelecani (Linnaeus, 1758)		●		●			●			●		●				●	●	●	●	RD, BT	G
Arctica islandica (Linnaeus, 1767)						●			●	●	●	●			●					RD, BT	3
Acanthocardia echinata (Linnaeus, 1758)		●		●						●		●					●			RD	G
Dosinia lupinus (Linnaeus, 1758)				●		●		●			●		●							RD, BT	D
Euspira catena (da Costa, 1778)					●	●						●							●	RD	*
Gari fervensis (Gmelin, 1791)			●	●									●				●			RD	*
Mactra stultorum (Linnaeus, 1758)					●			●								●	●			RD	
Ensis spp. Linnaeus, 1758		●		●	●	●	●			●	●		●		●	●				RD	2
Dosinia exoleta (Linnaeus, 1758)								●					●							RD, BT	G
| *Astarte* sp.												●								RD	*
Nucula nitidosa Winckworth, 1930																			●	RD	*
Spisula solida (Linnaeus, 1758)													●							BT	G
Nemertea																					
| indet.	●																			RD	
Sipuncula																					
| indet.															●					RD	

Table 2. Species presence/absence at BRG with fishing method and endangerment status (RD = ring dredge, BT = beam trawl) and endangerment status (1 = threatened by extinction, 2 = critically endangered, 3 = endangered, G = endangerment of unknown extent, R = extremely rare, D = data insufficient, * = less vulnerable, ne = not established). Sorted by phylum and by occurrence.

Taxon	Station														Fishing method	Status
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Annelida																
Lanice conchilega (Pallas, 1766)	●	●	●			●	●	●	●	●	●	●		●	RD	*
Ophelia borealis Quatrefages, 1866			●			●		●	●		●	●	●	●	RD, BT	
Nephtys hombergii Savigny in Lamarck, 1818	●										●				RD, BT	*
Nephtys longosetosa (Örsted, 1842)						●					●				RD, BT	*
Notomastus latericeus Sars, 1851			●					●							RD	
Nephtys caeca (Fabricius, 1780)	●														RD	*
| Goniadidae indet.	●		●												RD	
| Nephtys spp.	●	●	●	●	●		●	●	●		●		●	●	RD	
| Oligochaeta indet.			●						●						RD	
| Glyceridae indet.					●										RD	
| Sabellidae indet.								●							RD	
| Oligochaeta indet.								●							RD	
| Cirratulidae indet.															BT	
Arthropoda																
Liocarcinus holsatus (Fabricius, 1798)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	*
Thia scutellata (Fabricius, 1793)	●	●	●	●		●	●	●	●	●	●	●	●	●	RD	D
Liocarcinus depurator (Linnaeus, 1758)		●			●			●	●	●	●	●	●	●	RD, BT	*
Pagurus bernhardus (Linnaeus, 1758)		●	●	●					●	●			●	●	BT	*
Cancer pagurus Linnaeus, 1758						●			●	●		●	●	●	BT	*
Corystes cassivelaunus (Pennant, 1777)		●	●	●		●							●		RD, BT	*
Crangon crangon (Linnaeus, 1758)									●		●	●	●	●	BT	*
Macropodia rostrata (Linnaeus, 1761)											●	●			BT	*
Liocarcinus navigator (Herbst, 1794)	●														BT	R
Macropodia tenuirostris (Leach, 1814)									●						BT	

Taxon	Station														Fishing method	Status
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
Philocheras trispinosus (Hailstone in Hailstone, Westwood, 1835)														●	BT	D
Pisidia longicornis (Linnaeus, 1767)												●			BT	*
Processa modica modica Williamson in Williamson & Rochanaburanon, 1979										●					RD	D
| Inachidae indet.									●						BT	
Bryozoa																
Electra pilosa (Linnaeus, 1767)				●								●	●		BT	*
Chordata																
Limanda limanda (Linnaeus, 1758)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	*
Ammodytes marinus Raitt, 1934	●	●	●	●	●	●	●	●	●	●	●		●	●	RD, BT	D
Buglossidium luteum (Risso, 1810)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	*
Hyperoplus lanceolatus (Le Sauvage, 1824)	●	●	●	●	●	●			●	●	●	●	●	●	RD, BT	D
Arnoglossus laterna (Walbaum, 1792)	●	●	●			●		●	●	●	●	●	●	●	BT	*
Callionymus lyra Linnaeus, 1758	●	●	●				●	●	●	●	●	●	●	●	RD, BT	*
Pleuronectes platessa Linnaeus, 1758		●	●	●	●				●	●	●	●	●	●	RD, BT	*
Echiichthys vipera (Cuvier, 1829)	●	●	●	●			●				●	●		●	BT	*
Callionymus reticulatus Valenciennes, 1837	●	●							●	●	●	●		●	BT	D
Pomatoschistus minutus (Pallas, 1770)	●								●	●	●	●		●	BT	*
Eutrigla gurnardus (Linnaeus, 1758)	●	●	●						●	●					BT	*
Agonus cataphractus (Linnaeus, 1758)			●						●			●		●	BT	*
Gadus morhua Linnaeus, 1758					●						●	●		●	BT	+
Merlangius merlangus (Linnaeus, 1758)		●								●	●	●			BT	*
Pomatoschistus pictus (Malm, 1865)									●			●			BT	D
Ammodytes tobianus Linnaeus, 1758								●							BT	D
Callionymus maculatus Rafinesque, 1810			●												BT	D
Microstomus kitt (Walbaum, 1792)											●				BT	*
Branchiostoma lanceolatum (Pallas, 1774)	●		●			●	●	●	●		●	●	●	●	RD	G
| Gobiidae indet.											●			●	BT	
Cnidaria																
| Anthozoa indet.						●					●	●			BT	
Echinodermata																
Astropecten irregularis (Pennant, 1777)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD, BT	G
Asterias rubens Linnaeus, 1758	●	●	●	●		●	●	●	●	●	●	●	●	●	RD, BT	*
Echinocardium cordatum (Pennant, 1777)	●	●	●	●	●	●				●					RD	*
Ophiura ophiura (Linnaeus, 1758)	●	●	●	●											RD, BT	*
Psammechinus miliaris (P.L.S. Müller, 1771)		●	●	●								●			RD, BT	*
Mollusca																
Ensis sp. Schumacher, 1817	●	●	●	●	●	●	●	●	●	●	●	●	●	●	RD	
Chamelea striatula (da Costa, 1778)		●	●	●	●	●				●	●	●	●		RD, BT	ne
Laevicardium crassum (Gmelin, 1791)								●	●		●	●	●	●	RD, BT	*
Polititapes rhomboides (Pennant, 1777)							●	●			●	●	●	●	RD	*
Sepiola atlantica d'Orbigny, 1842	●									●	●	●	●	●	BT	D
Dosinia exoleta (Linnaeus, 1758)							●		●		●	●		●	RD	G
Dosinia lupinus (Linnaeus, 1758)	●		●												RD	D
Gari fervensis (Gmelin, 1791)		●								●					RD	*
Spisula solida (Linnaeus, 1758)												●	●		RD	G
Spisula subtruncata (da Costa, 1778)	●			●											RD, BT	G
Abra prismatica (Montagu, 1808)											●				RD	D
Arctica islandica (Linnaeus, 1767)												●			BT	3
Euspira catena (da Costa, 1778)					●										RD	*
Euspira nitida (Donovan, 1803)					●										RD	*
Lutraria angustior Philippi, 1844								●							RD	
Mactra stultorum (Linnaeus, 1758)						●									RD	G
Phaxas pellucidus (Pennant, 1777)					●										RD	*
Spisula elliptica (T. Brown, 1827)						●									RD	2

00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Pentagonal protostomium with two antennae and two similar palps. At first segment reduced dorsal tentacular cirri. Gills start at segments 4–6 to the posterior end.

Nephtys incisa Malmgren, 1865

New records. GERMANY – **North Sea** • SAR; 54° 52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54° 53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54° 41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Fragile body with 70–75 segments. Tentacular cirri as long as the antennae at first segment. 20 longitudinal rows of 1–5 papillae at pharynx.

Nephtys longosetosa Örsted, 1842

New records. GERMANY – **North Sea** • BRG; 53° 58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53° 54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Long and hairy body with 120 segments. Pentagonal protostomium with two antennae and two similar palps. Gills from segment 3 to the posterior end. Pharynx with mediodorsal papilla.

Family Opheliidae

Ophelia borealis Quatrefages, 1866

New records. GERMANY – **North Sea** • BRG; 54° 00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53° 58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Spindle-shaped body with a ventral grove, starting at chaetigers 6–9. Small and conical prostomium.

Family Terebellidae

Lanice conchilega (Pallas, 1766)

Figure 3D

New records. GERMANY – **North Sea** • BRG; 54° 00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53° 58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53° 57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Long body with 300 segments, very long abdomen and with numerous tentacles. 17 thoracic chaetigerous segments and many eyespots.

Phylum Arthropoda

Family Callianassidae

Callianassa subterranea (Montagu, 1808)

Figure 4A

New records. GERMANY – **North Sea** • SAR; 55° 12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Very small rostrum, third maxillipeds leg-like. Uropods as long as telson. Hairy propodus and merus.

Family Cancridae

Cancer pagurus Linnaeus, 1758

Figure 4B

New records. GERMANY – **North Sea** • BRG; 53° 59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53° 59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • 9 BRG; 53° 57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Developed lobes, equal chelipeds and dactylus styliform.

Family Cirolanidae

Eurydice pulchra Leach, 1815

New records. GERMANY – **North Sea** • SAR; 54° 53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Maxillipedes without coupling hooks on the inner border, distinct coxal plates on pereion segments 2–7.

Family Corystidae

Corystes cassivelaunus (Pennant, 1777)

Figure 4C

New records. GERMANY – **North Sea** • SAR; 54° 40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR;

54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54° 47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54° 49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54° 51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54° 52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54° 51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54° 54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54° 59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54° 41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54° 38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54° 33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53° 59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53° 59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53° 54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Very long carapace, frontal region produced and with a median longitudinal furrow. Small rostrum and bidentate.

Family Crangonidae

***Crangon allmanni* Kinahan, 1860**

Figure 4D

New records. GERMANY – **North Sea** • SAR; 54° 59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Unarmed rostrum, slimmer than *Crangon crangon* and distinguishable by the deep longitudinal dorsal groove in pleonite 6.

***Crangon crangon* (Linnaeus, 1758)**

Figure 4E

New records. GERMANY – **North Sea** • BRG; 53° 57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53° 54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Unarmed rostrum, triangular with rounded apex. Mandible with molar process only and teeth sharply pointed. Telson with two pairs of small lateral spines.

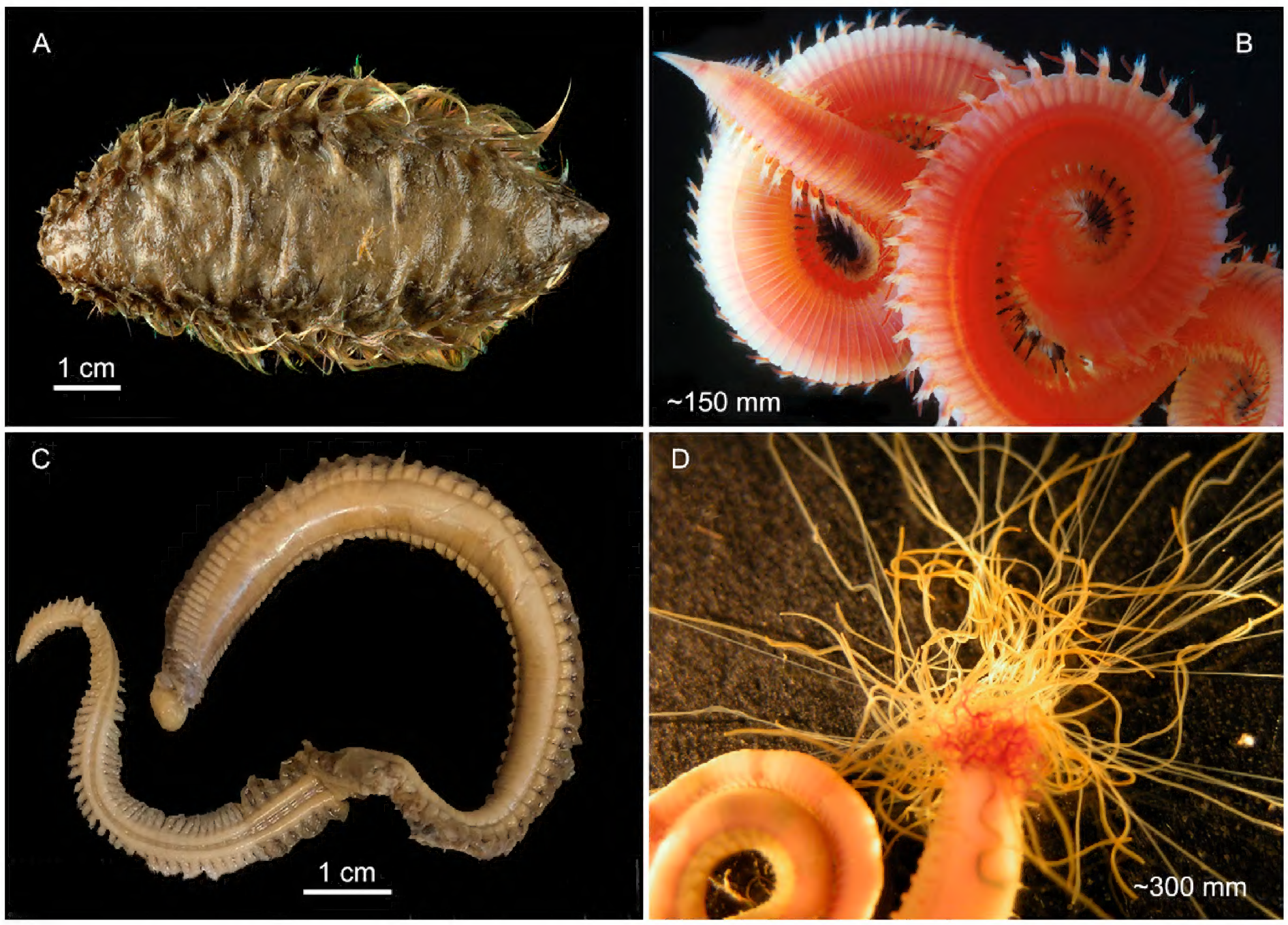


Figure 3. Examples of Annelida found at SAR and BRG, North Sea, Germany. **A.** *Aphrodita aculeata* © Sven Tränkner. **B.** *Glycera* sp. © Dieter Fieger. **C.** *Nephtys hombergii* © Alexander Knorrn. **D.** *Lanice conchilega* © Michael Tükay.

***Philocheras trispinosus* (Hailstone in Hailstone & Westwood, 1835)**
Figure 4F

New records. GERMANY – **North Sea** • BRG; 53° 56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. As in original description by Hailstone and Westwood (1835) of *Pontophilus trispinosus*.

Family Goneplacidae

***Goneplax rhomboides* (Linnaeus, 1758)**
Figure 4G

New records. GERMANY – **North Sea** • SAR; 55°12.91′ N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Very long Carapace and quadrangular. Long eyes and pereopods. Antero-lateral margins of carapace with first pair of teeth prominent and often acute, a smaller posteriorly placed pair often developed.

Family Inachidae

***Macropodia rostrata* (Linnaeus, 1761)**
Figure 4H

New records. GERMANY – **North Sea** • BRG; 53° 54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53° 54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Carapace appreciably narrowed anteriorly; frontal region produced as a tapering bifid rostrum. Carapace surface with numerous hook-setae prominent on rostrum, regions swollen and with tubercles; second and third peduncular segments of antenna slender and without spines.

***Macropodia tenuirostris* (Leach, 1814 in 1813–1815)**
Figure 4I

New records. GERMANY – **North Sea** • BRG; 53°57.00′ N, 006°17.55′E; 29.8 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Frontal region produced as a tapering rostrum, thin, long and deflected slightly upward and extending well beyond distal end of fifth peduncular segment of antennal peduncle.

Family Nephropidae

***Nephrops norvegicus* (Linnaeus, 1758)**
Figure 4J

New records. GERMANY – **North Sea** • SAR; 55° 12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Carapace with a distinct post-cervical groove and longitudinal spinose keels. Long and spinose rostrum, first legs with long, keeled chelae.

Family Paguridae

***Pagurus bernhardus* (Linnaeus, 1758)**
Figure 4K

New records. GERMANY – **North Sea** • SAR; 54°40.10′ N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006° 37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°54.63′N, 006° 38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006° 40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006° 49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007° 00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°59.98′N, 006° 15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Original description by Linnaeus (1758) of *Cancer pagurus*.

Family Polybiidae

***Liocarcinus depurator* (Linnaeus, 1758)**
Figure 4L

New records. GERMANY – **North Sea** • SAR; 54° 33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 53° 58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; Ring dredge and beam trawl.

Identification. Suboval, broader than long carapace, outer ventral margin of orbit with broadly U- to V-shaped incision.

***Liocarcinus holsatus* (Fabricius, 1798)**
Figure 4M

New records. GERMANY – **North Sea** • SAR; 54°44.12′ N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°59.70′N, 006° 40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N,

006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; Ring dredge and beam trawl.

Identification. Outer ventral margin of orbit with a moderately narrow incision. Antero-lateral margins of carapace with flat spinose teeth, fourth longer than third and with margin almost straight.

***Liocarcinus navigator* (Herbst, 1794)**
Figure 4N

New records. GERMANY – **North Sea** • 1 BRG; 54° 00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Antero-lateral margin of carapace with teeth alternating slightly in size, fourth smallest. Propodus with one setose, longitudinal ventral carina extending whole length of margin and a secondary obsolete shorter one distally, dactylus styliform.

Family Porcellanidae

***Pisidia longicornis* (Linnaeus, 1767)**
Figure 4O

New records. GERMANY – **North Sea** • SAR; 54° 49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • BRG; 53° 54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. As original description by Linnaeus (1767) of *Cancer pagurus*.

Family Processidae

***Processa nouveli holthuisi* Al-Adhub & Williamson, 1975**
Figure 4P

New records. GERMANY – **North Sea** • SAR; 55°12.91′ N, 006°12.23′E; 49.4 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; Ring dredge.

Identification. As original description by Al-adhub and Williamson (1975).

***Processa modica modica* Williamson in Williamson & Rochanaburanon, 1979**
Figure 4Q

New records. GERMANY – **North Sea** • BRG; 53° 56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Original description by Williamson and Rochanaburanon (1979).

Family Thiidae

***Thia scutellata* (Fabricius, 1793)**
Figure 4R

New records. GERMANY – **North Sea** • SAR; 54°59.70′ N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Carapace strongly convex transversely, anterio-lateral margins of carapace with three to four indistinct teeth. Chelipeds equal, slightly compressed. Second to fifth pereiopods compressed and setose.

Family Upogebiidae

***Upogebia deltaura* (Leach, 1816)**
Figure 4S

New records. GERMANY – **North Sea** • SAR; 54°53.28′ N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Lacking the ocular spines in contrast to *Upogebia stellata*. Abdomen broader and more softy membranous than *Upogebia stellata*.

Phylum Bryozoa
Family Electridae

***Electra pilosa* (Linnaeus, 1767)**
Figure 5

New records. GERMANY – **North Sea** • SAR; 54°47.82′ N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006° 38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006° 07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°38.75′N, 006° 54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007° 00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°59.93′N, 006° 19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°54.89′N, 006°

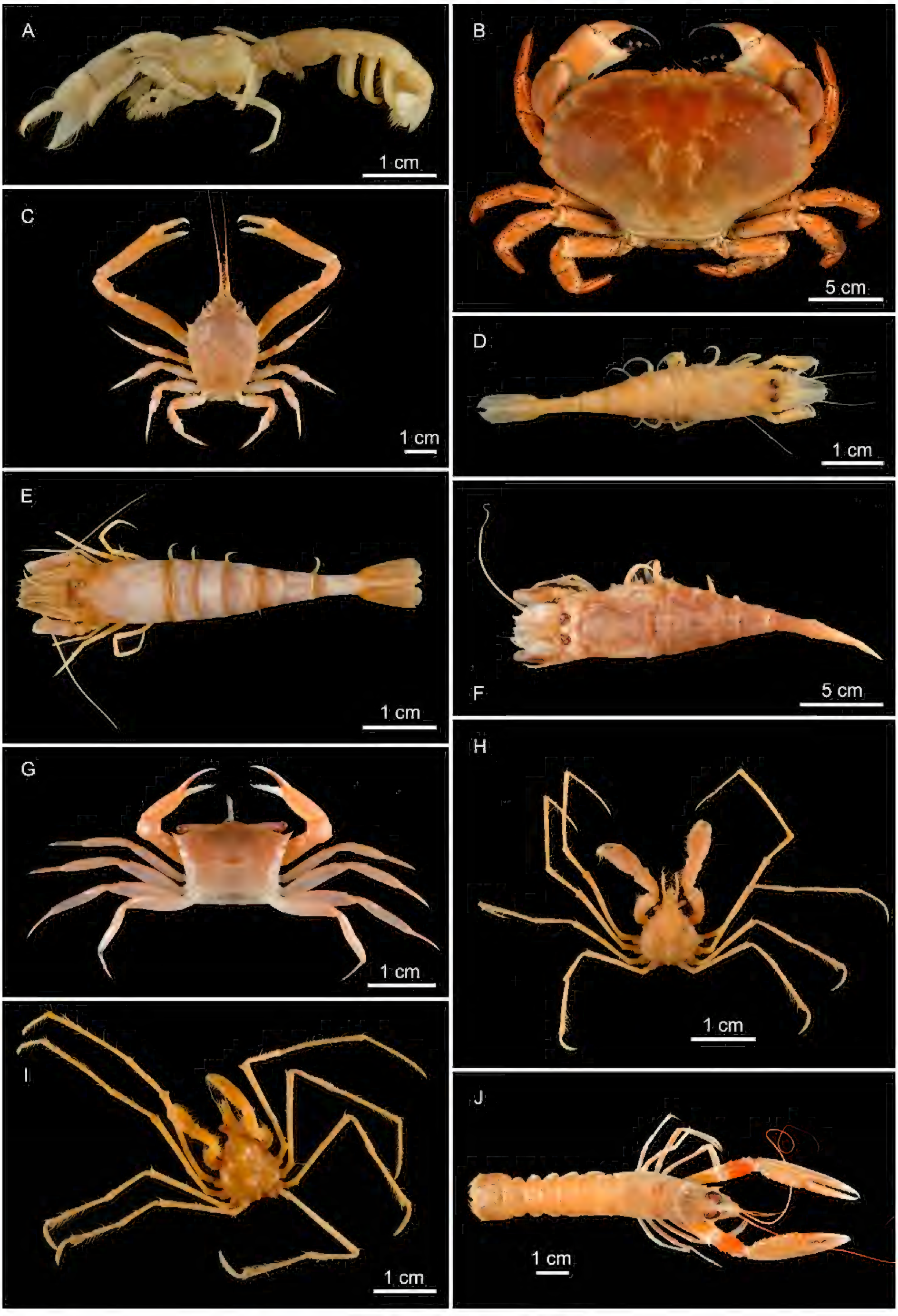


Figure 4. Examples of Arthropoda found at SAR and BRG, North Sea, Germany. **A.** *Callianassa subterrana*. **B.** *Cancer pagurus*. **C.** *Corystes cassivelaunus*. **D.** *Crangon allmanni*. **E.** *Crangon crangon*. **F.** *Philocheras trispinosus*. **G.** *Goneplax rhomboides*. **H.** *Macropodia rostrata*. **I.** *Macropodia tenuirostris*. **J.** *Nephrops norvegicus*.

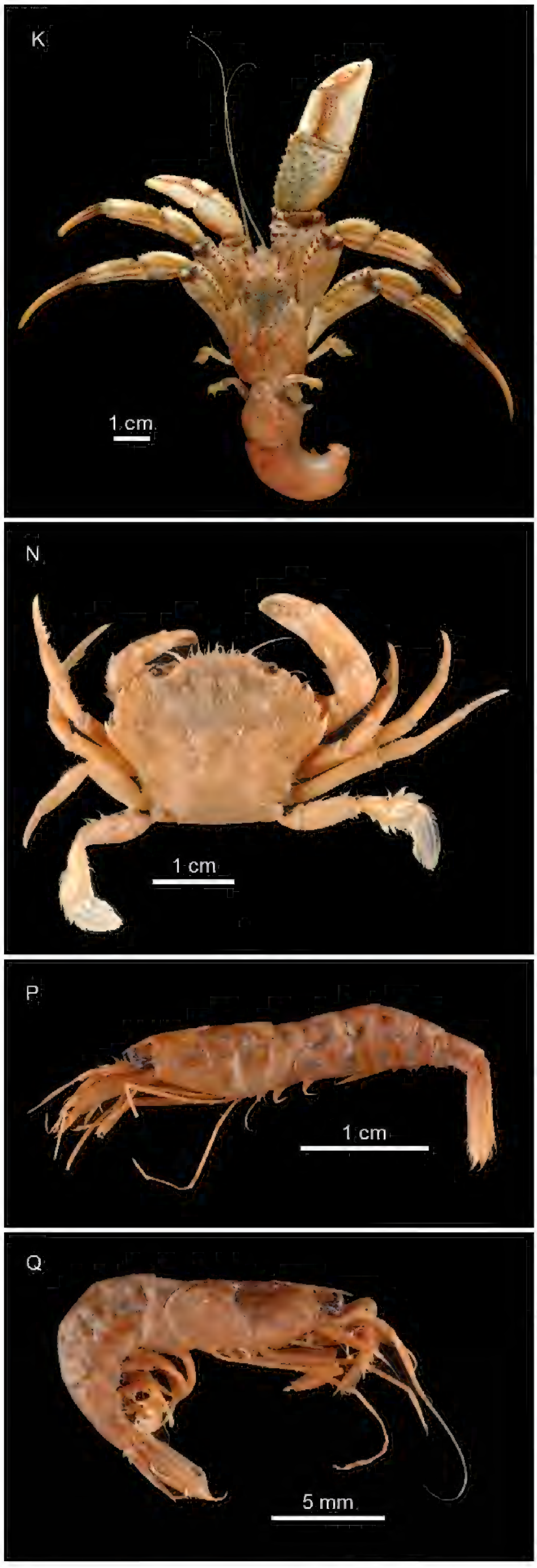


Figure 4 (continued). Examples of Arthropoda found at SAR and BRG, North Sea, Germany. **K.** *Pagurus bernhardus*. **L.** *Liocarcinus depurator*. **M.** *Liocarcinus holsatus*. **N.** *Liocarcinus navigator*. **O.** *Pisidia longicornis*. **P.** *Processa nouveli holthuisi*. **Q.** *Processa modica modica*. **R.** *Thia scutellata*. **S.** *Upogebia deltaura*. All photographs © Sven Tränkner.

Figure 5. Example of *Electra pilosa* found at SAR and BRG, North Sea, Germany © Klaus Breitenbach.

17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006° 18.98′E; 28.5 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Original description of *Flustra Pilosa* by Linnaeus (1767).

Phylum Chordata
Family Agonidae

***Agonus cataphractus* (Linnaeus, 1758)**
Figure 6A

New records. GERMANY – **North Sea** • SAR; 54°51.21′ N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. No barbels on snout tip, nasal tube short, never reaching upper jaw. Two nasal spines, one directed forward, one recurved posterodorsally, no ethmoidal spine. Two or three maxillary barbels, no occipital pit.

Family Ammodytidae

***Ammodytes marinus* Raitt, 1934**
Figure 6B

New records. GERMANY – **North Sea** • BRG; 54°00.09′ N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53° 59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54° 00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53° 59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53° 58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53° 57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53° 57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53° 57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53° 56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53° 54.90′N, 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53° 54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53° 56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Plicae 140–150. Dorsal rays 56–63; anal rays 29–33. Scales absent from a median band anterior to the dorsal fin and from the musculature at the base of caudal fin.

***Ammodytes tobianus* Linnaeus, 1758**
Figure 6B

New records. GERMANY – **North Sea** • BRG; 53° 57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Plicae 120–138. Dorsal rays 49–58; anal rays 24–32. Scales present in the midline anterior to dorsal fin and over the musculature at base of caudal fin.

***Hyperoplus lanceolatus* (Le Sauvage, 1824)**
Figure 6C

New records. GERMANY – **North Sea** • SAR; 54°59.703′ N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Pectoral fins 27–32% of head length, and not reaching level of first dorsal finray. Plicae 165–195.

Family Ascidiidae

***Ascidiella scabra* (Müller, 1776)**

New records. GERMANY – **North Sea** • SAR; 54°59.70′ N, 006°40.32′E; 42.5 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Test smooth or wrinkled, cartilaginous, and bears small, red papillae around the siphons. Oral siphon with 6–8 lobes and placed terminal.

Family Bothidae

***Arnoglossus laterna* (Walbaum, 1792)**
Figure 6D

New records. GERMANY – **North Sea** • SAR; 54° 40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR;

54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Snout as long as or longer than diameter of eye. Lateral line with 50–56 scales.

Family Branchiostomatidae

***Branchiostoma lanceolatum* (Pallas, 1774)**
Figure 6E

New records. GERMANY – **North Sea** • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Elongated and laterally compressed, pointed at both ends. No skin or scale. Mouth inferior, surrounded with 20–30 cirri. A persistent notochord is present from front to caudal end.

Family Callionymidae

***Callionymus lyra* Linnaeus, 1758**
Figure 6F

New records. GERMANY – **North Sea** • SAR; 54°40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Eye in head, strong antrorse spine at base. Yellowish-brown, adult males with blue spots and stripes on head, body, and dorsal fins; females and young males with saddles and green-brown blotches.

***Callionymus maculatus* Rafinesque, 1810**
Figure 6G

New records. GERMANY – **North Sea** • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Light brown, with dark and silvery spots. Second dorsal in males with four horizontal rows of dark spots; in females with 2 rows.

***Callionymus reticulatus* Valenciennes, 1837**
Figure 6H

New records. GERMANY – **North Sea** • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Orange or brown dorsally, with six darker patches, belly white. Second dorsal in males with dark blotches in vertical or oblique rows, in females colorless. Last two anal finrays not enlarged.

Family Clupeidae

***Clupea harengus* Linnaeus, 1758**
Figure 6I

New records. GERMANY – **North Sea** • SAR; 54°45.38′

N, 006°43.21′E; 41.8 m dp.; 09.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Elongate, lower jaw projecting; gill cover without radiating bony striae. Pelvic fin with usually nine finrays.

Family Gadidae

***Gadus morhua* Linnaeus, 1758**
Figure 6J

New records. GERMANY – **North Sea** • BRG; 53°58.12′ N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53° 54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 •14 BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Three dorsal finrays (14–15, 18–22, 17–20), two anal finrays. Densely mottled with small brownish or greyish marks on the sides and back; belly white.

***Merlangius merlangus* (Linnaeus, 1758)**
Figure 6K

New records. GERMANY – **North Sea** • SAR; 54° 49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 55° 12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Three dorsal finrays (12–15; 18–25; 19–22), two analy finrays. Yellowish-brown, dark blue or green; sides yellowish-grey, and white and silvery on belly.

Family Gobiidae

***Pomatoschistus minutus* (Pallas, 1770)**
Figure 6L

New records. GERMANY – **North Sea** • BRG; 54°00.09′ N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53° 57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Eyes dorsolateral, lateral line system. Caudal fin rounded. Sandy or grey with fine darker reticulation and ferruginous specks; first dorsal fin rear dark spot.

***Pomatoschistus pictus* (Malm, 1865)**
Figure 6M

New records. GERMANY – **North Sea** • BRG; 53° 57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Lateral line system with suborbital row a having one transverse row; eyes dorsolateral. Branchiostegal membrane attached to entire side of isthmus. Predorsal area and breast naked. Coarse dark reticulation, four pale saddles across back and 4 "double spots" along lateral midline.

Family Pleuronectidae

***Hippoglossoides platessoides* (Fabricius, 1780)**
Figure 6N

New records. GERMANY- **North Sea** • SAR; 54° 49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Branchiostegal rays eight, dorsal finrays 76–101; anal finrays 60–79. Lateral line scales 85–97, brownish.

***Limanda limanda* (Linnaeus, 1758)**
Figure 6O

New records. GERMANY – **North Sea** • SAR; 54°44.12′ N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006° 35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006° 32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006° 38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006° 12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Dorsal finrays 65–81; anal finrays 50–64. Lateral line scales 73–90. Eyed side often with small rusty-red spots.

***Microstomus kitt* (Walbaum, 1792)**
Figure 6P

New records. GERMANY – **North Sea** • SAR; 54° 49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Dorsal finrays 85–97; anal finrays 69–76; eyed side marbled, lateral line scales 110–125. Brownish or greyish, often spotted, marbled or blotched with paler and darker marks; usually some dark spots on median fins.

***Pleuronectes platessa* Linnaeus, 1758**
Figure 6Q

New records. GERMANY – **North Sea** • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54° 53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Dorsal finrays 65–79, anal finrays 48–59. Lateral line scales 88–115.

Family Rajidae

***Raja clavata* Linnaeus, 1758**
Figure 6R

New records. GERMANY – **North Sea** • SAR; 54° 53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020; Lehnhoff and M. Sonnewald leg.; beam trawl.

Identification. Upper surfaces wholly prickly, orbital thorns separate, a regular row of 30–50 thorns from nape to first dorsal. All shades of brown, variegated with dark and light spots and blotches, often marbled or producing patterns like eyespots; underside white.

Family Soleidae

***Buglossidium luteum* (Risso, 1810)**
Figure 6S

New records. GERMANY – **North Sea** • SAR; 54°40.10′ N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28’N, 006° 32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006° 38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006° 40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge and beam trawl.

Identification. Oval body. Anterior nostril on blind side not enlarged, anterior nostril on eyed side with a backward-pointing tube, reaching to vertical through front margin of lower eye. Dorsal fin beginning on the anterior profile of head, with 65–78 finrays; caudal fin united to dorsal and anal fins by a membrane. Scales rectangular; eyed side sandy yellow or light brown, with small brown or two grey spots.

Family Trachinidae

***Echiichthys vipera* (Cuvier, 1829)**
Figure 6T

New records. GERMANY – **North Sea** • BRG; 54° 00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 •BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG;

53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Yellowish-brown with brown spots often forming some longitudinal lines on sides.

Family Triglidae

***Eutrigla gurnardus* (Linnaeus, 1758)**

Figure 6U

Observations. GERMANY – **North Sea** • SAR; 54°40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Head without deep occipital groove. First

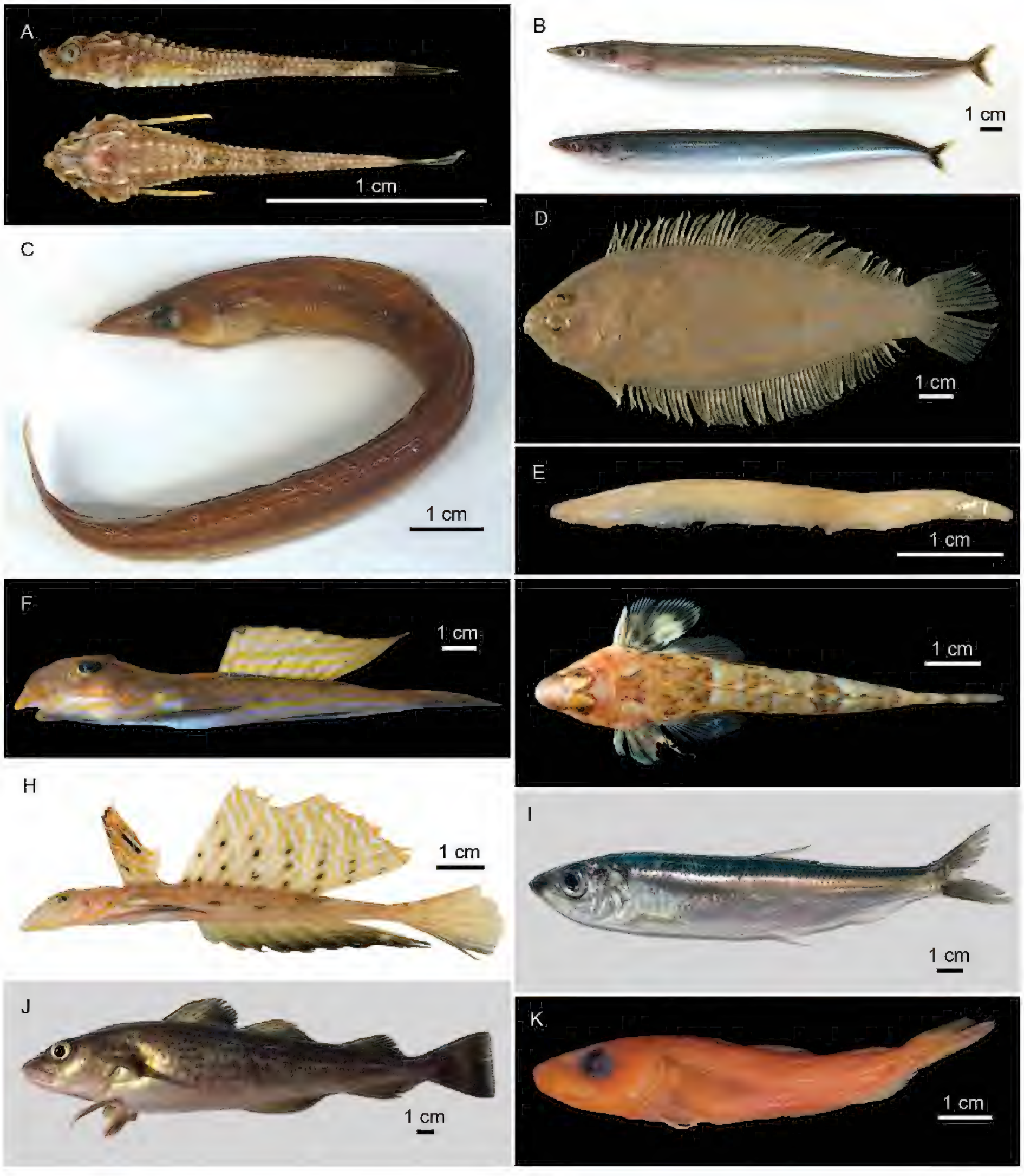


Figure 6. Examples of Chordata found at SAR and BRG, North Sea, Germany. **A.** *Agonus cataphractus*. **B.** *Ammodytes marinus* (above) and *Ammodytes tobianus* (below). **C.** *Hyperoplus lanceolatus*. **D.** *Arnoglossus laterna*. **E.** *Branchiostoma lanceolatum*. **F.** *Callionymus lyra*. **G.** *Callionymus maculatus*. **H.** *Callionymus reticulatus*. **I.** *Clupea harengus*. **J.** *Gadus morhua*. **K.** *Merlangius merlangus*.

Figure 6 (continued). Examples of Chordata found at SAR and BRG, North Sea, Germany. **L.** *Pomatoschistus minutus*. **M.** *Pomatoschistus pictus*. **N.** *Hippoglossoides platessoides*. **O.** *Limanda limanda*. **P.** *Microstomus kitt*. **Q.** *Pleuronectes platessa*. **R.** *Raja clavata*. **S.** *Buglossidium luteum*. **T.** *Echiichthys vipera*. **U.** *Eutrigla gurnardus*. A, D, G, H, L, N–Q, S, T © Sven Tränkner; B, C, E, F, I–K, M, R, U © Alexander Knorrn.

dorsal fin with 7–10 spines, second dorsal fin with 18–20 rays and 17–20 anal rays; pectoral fins short. Breast naked and belly partially scaled. Greyish brown with a red tinge on back and sides, underside cream-colored.

Phylum Cnidaria
Family Campanulariidae

***Obelia geniculata* (Linnaeus, 1758)**
Figure 7A

New records. GERMANY – **North Sea** • SAR; 54°47.82′ N, 006°46.25′E; 43.8 m dp.; 09.V.2020; M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. As original description of *Sertularia geniculata* by Linnaeus (1758).

***Obelia longissima* (Pallas, 1766)**
Figure 7B

New records. GERMANY – **North Sea** • SAR; 54°52.95′ N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. As original description of *Sertularia longissima* by Pallas (1766).

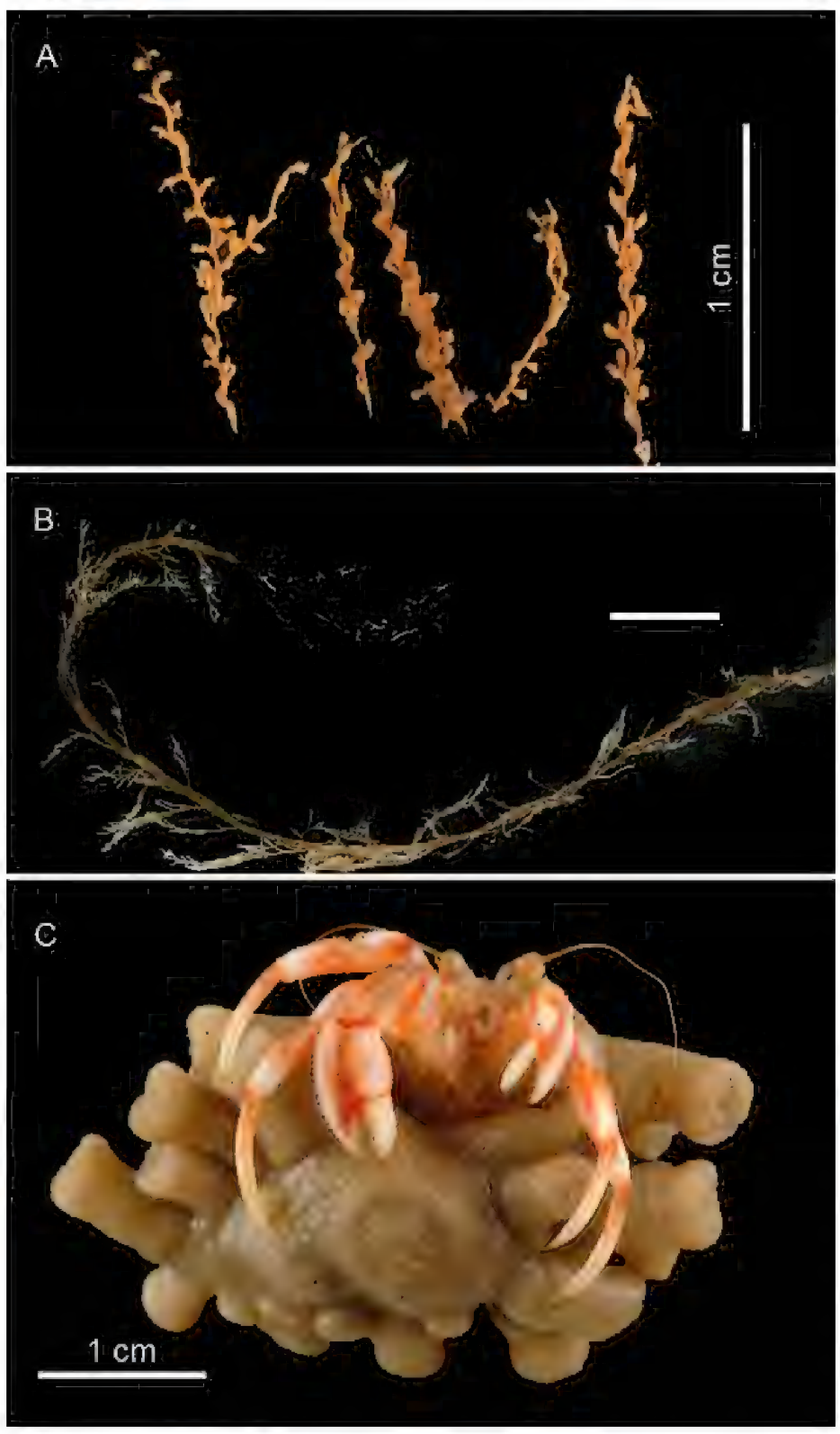


Figure 7. Examples of Cnidaria found at SAR and BRG, North Sea, Germany. **A.** *Obelia geniculata*. **B.** *Obelia longissima*. **C.** *Epizoanthus papillosus* on *Pagurus bernhardus*. A, B © Alexander Knorrn; C © Sven Tränkner.

Family Epizoanthidae

***Epizoanthus papillosus* Johnston, 1842**
Figure 7C

New records. GERMANY – **North Sea** • SAR; 54° 51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 55° 03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Original description of *Dysidea papillosa* by Johnston (1842).

Phylum Echinodermata
Family Amphiuridae

***Amphiura chiajei* Forbes, 1843**
Figure 8A

New records. GERMANY – **North Sea** • SAR; 55°12.91′ N, 006°12.23′E; 49.4 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Body with a central disc of up to 11 mm in diameter and five fine arms of about eight times that length, reddish or greyish brown. Disc covered with fine scales on both sides, primary plates are generally distinct, radial shields are separated.

Family Asteriidae

***Asterias rubens* Linnaeus, 1758**
Figure 8B

New records. GERMANY – **North Sea** • SAR; 54°40.10′ N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28’N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.03′N,

006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Body with small disc and five rather short, broad, tapering arms. Highly flexible skin with numerous small papulae, occurring in groups of three. On the oral side straight pedicellaria are found, especially attached to the inner furrow spines, but also on the sides of the adambulacral plates, within the furrow.

Family Astropectinidae

***Astropecten irregularis* (Pennant, 1777)**
Figure 8C

New records. GERMANY – **North Sea** • SAR; 54°40.10′ N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°57.59′N, 006°15.271′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Body with a fairly large disc and five rather short, stiff, tapering arms, reddish violet or yellowish. Upper surface is covered with paxillae; upper and lower rows of marginal plates are well marked and with a larger, conical spine, especially on the outer parts of the arms. The adambulacral plates each bear three equal-sized furrow spines; no pedicellariae. The tube-feet are pointed, suckerless, and provided with double ampullae.

Family Brissidae

***Brissopsis lyrifera* (Forbes, 1841)**

New records. GERMANY – **North Sea** • SAR; 55° 12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Body oval, arched, sloping anteriorly. The frontal ambulacrum is rather deep, forming a conspicuous notch in the anterior end of the body. The posterior petals are shorter than the anterior ones and diverging. Peripetalous fasciole encircling all five petals of the ambulacra on the upper side of the body.

Family Cucumariidae

***Paraleptopentacta elongata* (Düben and Koren, 1846)**

New records. GERMANY – **North Sea** • SAR; 54°49.06′ N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53,28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Original description of *Trachythyone elongata* by von Düben and Koren (1844).

Family Loveniidae

***Echinocardium cordatum* (Pennant, 1777)**
Figure 8D

New records. GERMANY – **North Sea** • SAR; 54° 40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54° 53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54° 54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°

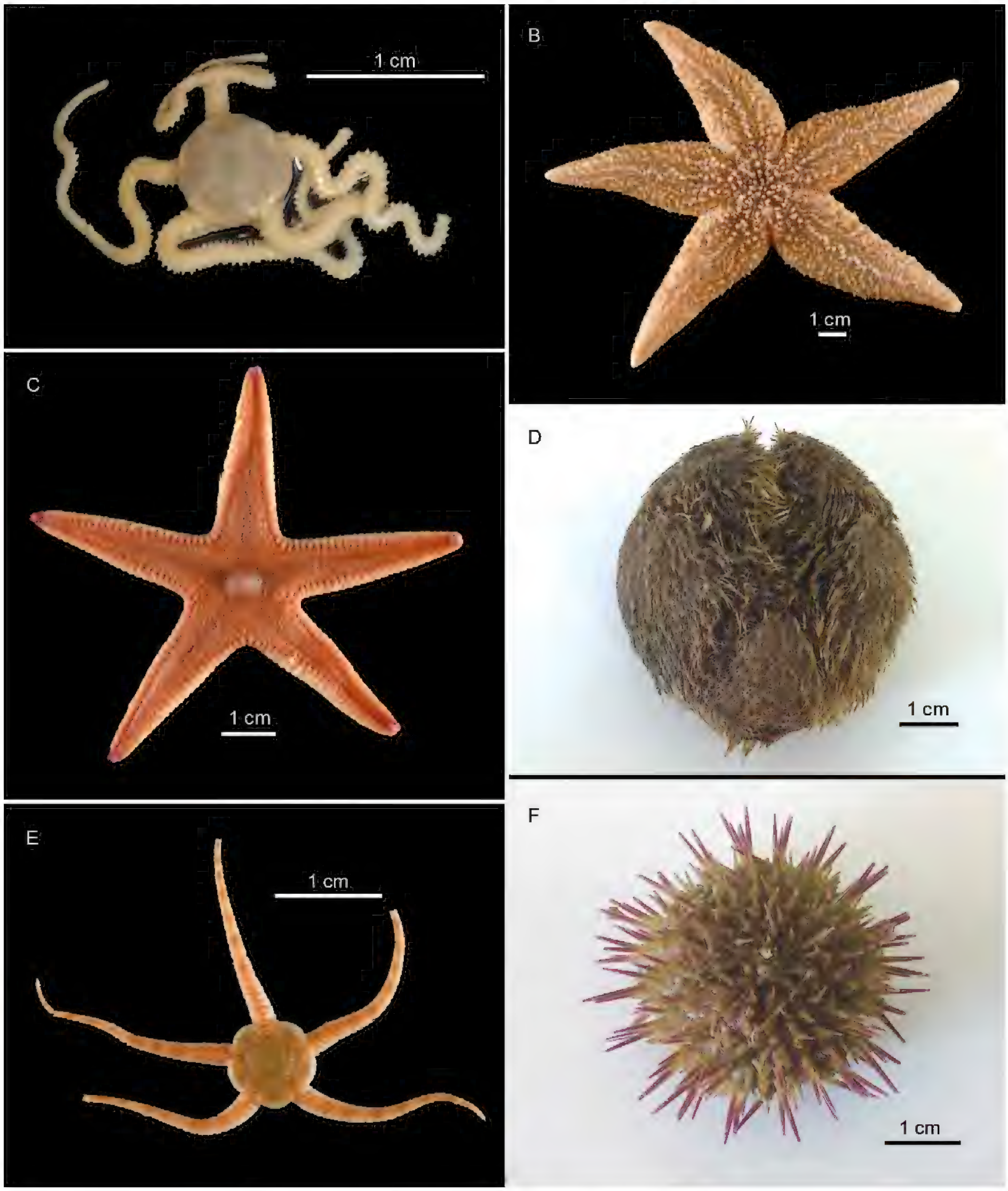


Figure 8. Examples of Echinodermata found at SAR and BRG, North Sea, Germany. **A.** *Amphiura chajei*. **B.** *Asterias rubens*. **C.** *Astropecten irregularis*. **D.** *Echinocardium cordatum*. **E.** *Ophiura ophiura*. **F.** *Psammechinus miliaris*. A, D, F© Alexander Knorrn; B, C, E © Sven Tränkner.

59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54° 41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54° 38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54° 33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Frontal ambulacrum rather deeply sunk, the furrow continuing from the anterior end to the apical system. Tube feet confined to the ambulacra. Blades have five or six teeth along each side of the terminal opening. The tridentate pedicellariae have leaf-shaped blades,

with the edges of the lower part irregularly serrated. The triphyllous pedicellariae have a series of broad teeth inside the edge.

Family Ophiuridae

***Ophiura ophiura* (Linnaeus, 1758)**
Figure 8E

New records. GERMANY – **North Sea** • SAR; 54° 40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Body with a central disc of up to 35 mm in diameter and 5 short straight arms of about 3.5 times that length, scales on the disc are rather coarse. Primary plates on the dorsal side of the disc are distinct. Ventral arm plates with a convex outer edge and they are separated by a pair of pore-shaped grooves in the mid-line of the arm.

Family Parechinidae

***Psammechinus miliaris* (P.L.S. Müller, 1771)**
Figure 8F

New records. GERMANY – **North Sea** • BRG; 53° 59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Body with a central disc of up to 35 mm in diameter and five short straight arms of about 3.5 times that length. Primary plates on the dorsal side of the disc are distinct, especially the central one. Three pairs of arm spines lying flat against the arms. Tube-foot pores in the proximal part of the arm have three or four tentacle scales. Single, vertical row of teeth on top of the jaw and 4–6 mouth papillae on each side of the jaw.

Family Spatangidae

***Spatangus purpureus* O.F. Müller, 1776**

New records. GERMANY – **North Sea** • SAR; 54°59.70′ N, 006°40.32′E; 42.5 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Ambulacra on upper side of test petaloid, widened, scarcely deepened. Frontal ambulacrum rather deep, forming a conspicuous broad notch in anterior edge of the test. First plate of posterior interambulacrum developed into a prominent lip, partly covering the mouth and the transversely elongated peristome. Sphaeridia present, not in grooves, tube feet confined to the ambulacra.

Phylum Mollusca
Family Aporrhaidae

***Aporrhais pespelecani* (Linnaeus, 1758)**
Figure 9A

New records. GERMANY – **North Sea** • SAR; 54° 44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Palmate extension to the outer lip, spire tall, whorls tumid, with crescentic costae and fine, flat spiral striae; apical whorls finely decussate or with spiral striae only. Ridges extend on to palmate outer lip but are not tuberculate at this point. Aperture in mature shells dominated by palmate outer lip; uppermost process fuses with lower part of spire, extending to antepenultimate whorl; basal process curved upward towards aperture.

Family Arcticidae

***Arctica islandica* (Linnaeus, 1767)**
Figure 9B

New records. GERMANY – **North Sea** • SAR; 54° 47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54° 53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Shell thick and strong, broadly oval, with prominent umbones. Anterior hinge line strongly curved, lunule poorly defined. Right valve with three prominent

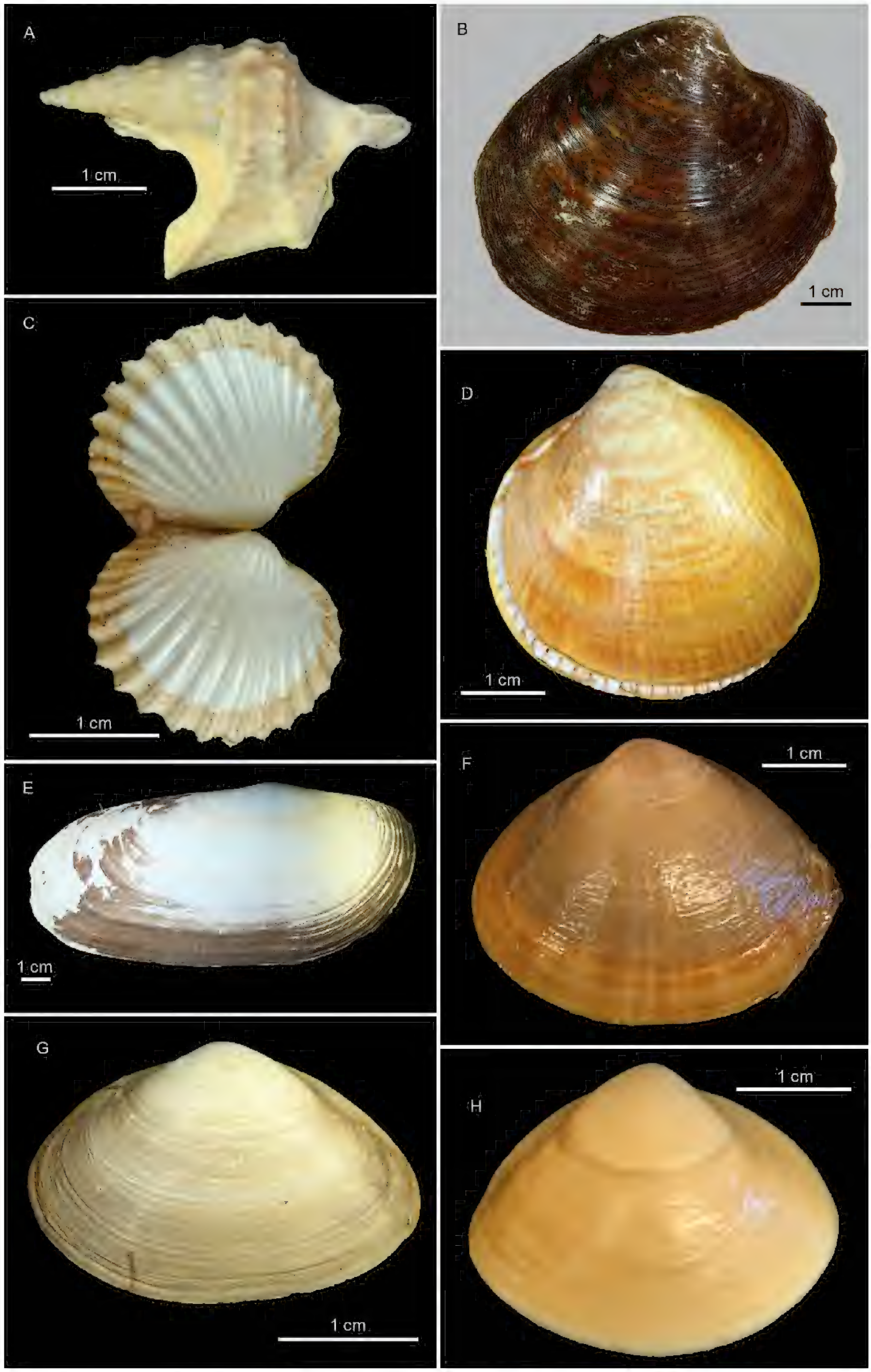
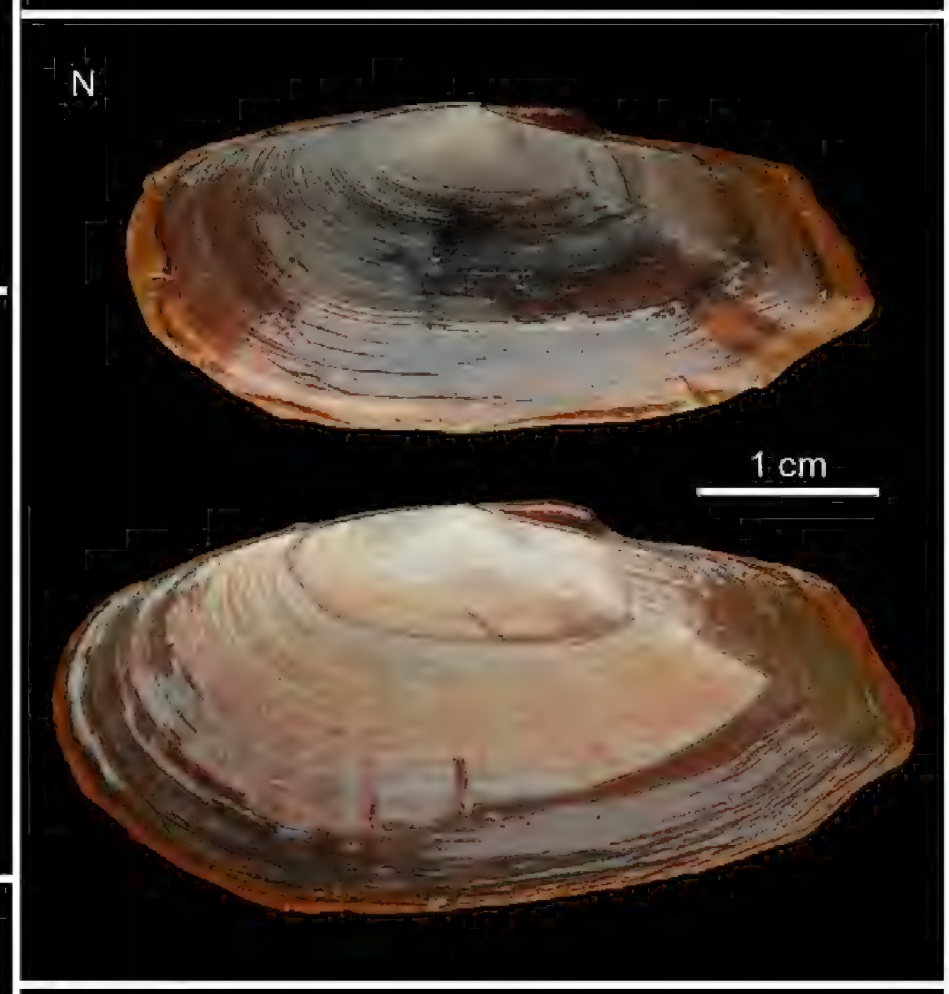
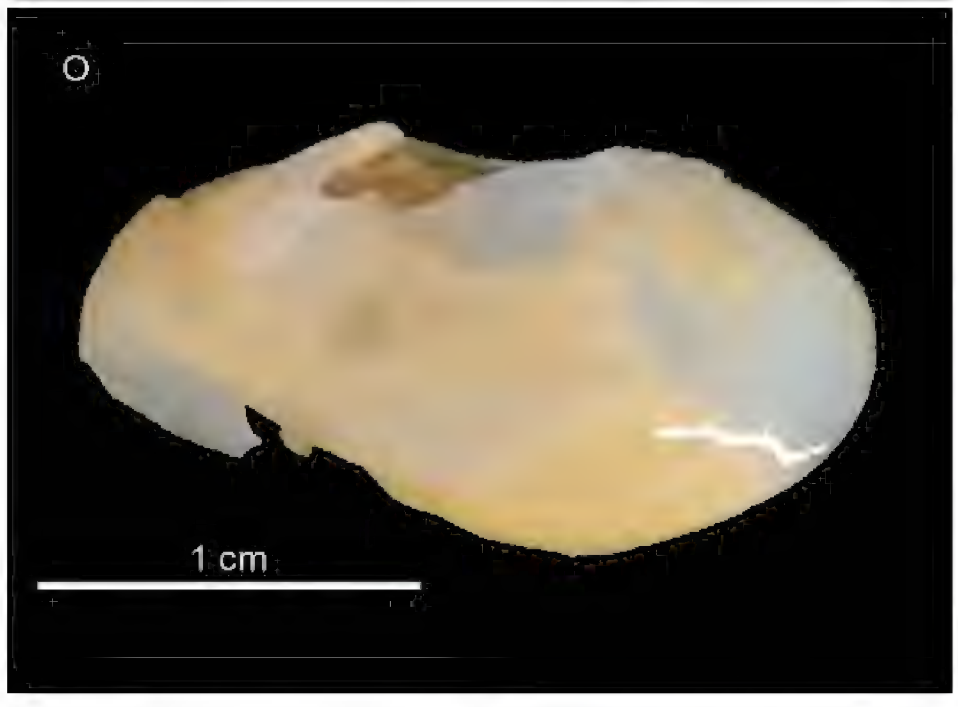


Figure 9. Examples of Mollusca found at SAR and BRG, North Sea, Germany. **A.** *Aporrhais pespelecani*. **B.** *Arctica islandica*. **C.** *Acanthocardia echinata*. **D.** *Laevicardium crassum*. **E.** *Lutraria angustior*. **F.** *Mactra stultorum*. **G.** *Spisula elliptica*. **H.** *Spisula solida*.





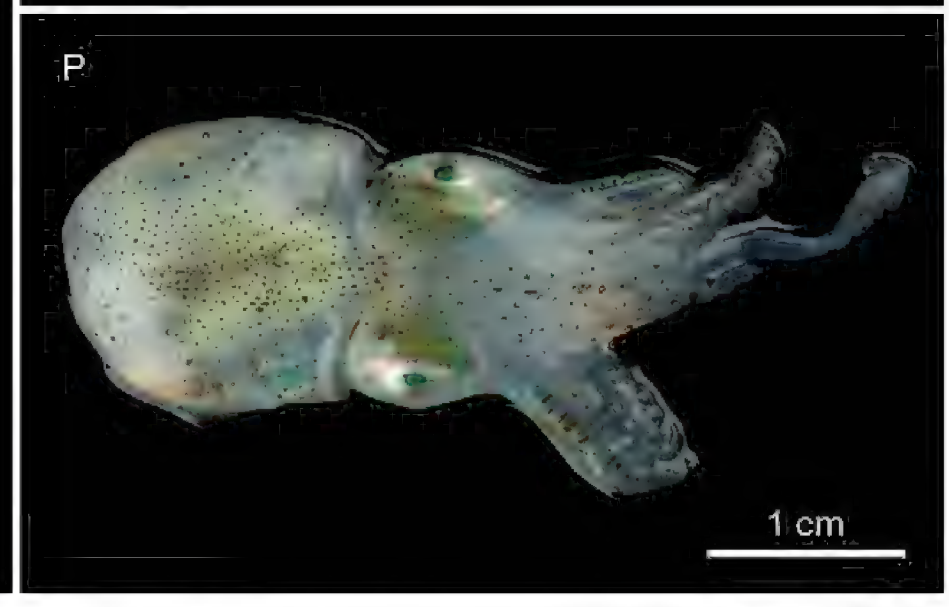


Figure 9 (continued). Examples of Mollusca found at SAR and BRG, North Sea, Germany. **I.** *Spisula subtruncata*. **J.** *Euspira catena*. **K.** *Euspira nitida*. **L.** *Nucula nitidosa*. **M.** *Phaxas pellucidus*. **N.** *Gari fervensis*. **O.** *Abra prismatica*. **P.** *Sepiola atlantica*.

Figure 9 (continued). Examples of Mollusca found at SAR and BRG, North Sea, Germany. **Q.** *Chamelea striatula*. **R.** *Dosinia exoleta*. **S.** *Dosinia lupinus*. **T.** *Polititapes rhomboides*. A–F, H, L, N, © Siegrid Hof; G, I, J, P, S, U © Alexander Knorrn; K, M, O, Q, T © Sven Tränkner.

cardinal teeth and a single posterior lateral tooth; triangular pit in front of anterior cardinal, surrounded by small knobs and ridges. Left valve with three cardinals and one posterior lateral, anterior cardinal continuous with a series of small ridges and denticulations.

Family Astartidae

***Astarte* sp.**

New records. GERMANY – **North Sea** • SAR; 54° 54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Family Cardiidae

***Acanthocardia echinata* (Linnaeus, 1758)**
Figure 9C

New records. GERMANY – **North Sea** • SAR; 54° 44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell brittle, obliquely oval, anterior hinge line sloping gently to convex anterior margin. Ribs 18–23, each with a sharp central keel. Concentric sculptures of numerous wavy ridges, pronounced between ribs. Two cardinal teeth in each valve; right valve with two anterior and one posterior lateral tooth, left valve with single anterior and posterior lateral teeth, the anterior being longer, thicker, and more prominent than posterior one. Adductor scars and pallial line indistinct.

***Laevicardium crassum* (Gmelin, 1791)**
Figure 9D

New records. GERMANY – **North Sea** • BRG; 53° 57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Shell thick, shallowly convex; obliquely oval. Faint ribs, most conspicuous ventrally, concentrated on middle regions of shell and absent from areas adjoining anterior and posterior margins. Each valve

with two cardinal teeth; right posterior tooth considerably larger than right anterior tooth. Right valve with two anterior and one posterior lateral; left valve with single anterior and posterior laterals, anterior being much larger than posterior. Adductor scars distinct.

Family Mactridae

***Lutraria angustior* Philippi, 1844**
Figure 9E

New records. GERMANY – **North Sea** • BRG; 53° 57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell elongate, anterior hinge line sloping more steeply than posterior, gaping at both ends. Umbones anterior to midline. Right valve with two cardinal teeth and a single, poorly developed, posterior lateral. Left valve with anterior two cardinal teeth forming a solid, forked structure, third thin and indistinct; and single, thin anterior and posterior laterals. Adductor scars and pallial line distinct.

***Mactra stultorum* (Linnaeus, 1758)**
Figure 9F

New records. GERMANY – **North Sea** • SAR; 54° 49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell thin and brittle, oval, umbones just anterior to midline. Sculpture of very fine concentric lines. Right valve with two cardinal teeth, the anterior parallel to hinge line, and paired, elongate anterior and posterior laterals. Left valve with three cardinal teeth; anterior two joined to form a single, widely forked structure, the third poorly developed, and single elongate anterior and posterior laterals. Chondrophore triangular, posterior to the cardinal teeth in each valve, with a small dorsal septum isolating it from the external ligament.

***Spisula elliptica* (T. Brown, 1827)**
Figure 9G

New records. GERMANY – **North Sea** • BRG; 53° 58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell thin, elongate oval, umbones close to midline. Lunule and escutcheon poorly defined. Right valve with two separate but closely spaced cardinal teeth, and paired elongate anterior and posterior laterals. Left valve with three cardinal teeth: the anterior two forming a single forked structure extending almost to edge of the hinge plate, the third small and indistinct; with single anterior and posterior laterals. Interlocking surfaces of lateral teeth serrated. Chondrophore posterior to cardinal teeth. Adductor scars and pallial line distinct, pallial sinus oval, extending to a point below and beyond midline of posterior lateral teeth.

***Spisula solida* (Linnaeus, 1758)**
Figure 9H

New records. GERMANY – **North Sea** • SAR; 54° 59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Shell thick and strong, subtriangular, anterior more regularly convex than posterior, umbones more or less on midline. Sculpture of fine concentric lines developed as fine ridges in front of and behind umbones; growth stages distinct. Right valve with two short cardinal teeth and paired, elongate anterior and posterior laterals. Left valve with three cardinal teeth; anterior two forming a forked structure which extends only halfway down hinge plate, third very small; single, elongate anterior and posterior laterals. Interlocking surfaces of lateral teeth serrated. Chondrophore posterior to cardinal teeth. Pallial sinus linguiform, extending to a point below and beyond the midline of the posterior laterals.

***Spisula subtruncata* (da Costa, 1778)**
Figure 9I

New records. GERMANY – **North Sea** • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Shell thick and strong, subtriangular but distinctly asymmetrical; umbones close to midline. Sculpture of fine concentric lines and grooves, growth stages clear. Lunule and escutcheon broad and elongate, latter bounded by low ridges extending from umbones. Right valve with two short cardinal teeth and paired, elongate anterior and posterior laterals. Left valve with three cardinal teeth; anterior two forming a single forked structure extending almost to edge of the hinge plate, third very small, indistinct; with single elongate anterior and posterior laterals. Interlocking surfaces of lateral teeth serrated. Chondrophore posterior to cardinal teeth. Adductor scars and pallial line distinct.

Family Naticidae

***Euspira catena* (da Costa, 1778)**
Figure 9J

New records. GERMANY – **North Sea** • SAR; 54°49.06′ N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Similar to *Euspira nitida*. Spire more elevated, with stepped profile and well-defined sutures. Outer lip arises almost at right angles to last whorl; umbilicus deep, round, occlusion by inner lip very slight.

***Euspira nitida* (Donovan, 1803)**
Figure 9K

New records. GERMANY – **North Sea** • BRG; 53° 58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell glossy, globose, with 6–7 slightly tumid whorls; last whorl accounts for most of shell height; sutures shallow, spire almost flat-sided. Sculpture of numerous, fine, prosocline growth lines; smooth to naked eye. Periostracum often retained within umbilicus. Aperture large, almost semicircular, with a thickened peristome; outer lip arises tangential to last whorl; inner lip partially occludes rather elongate umbilicus, and swells to fill angle between outer lip and last whorl.

Family Nuculidae

***Nucula nitidosa* Winckworth, 1930**
Figure 9L

New records. GERMANY – **North Sea** • SAR; 54° 33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell solid, equivalve; inequilateral, beaks behind the midline; triangular in outline. Anterior hinge line curving about the horizontal when the posterior is vertical; 20–30 hinge teeth anteriorly, 10–14 posteriorly; lunule lanceolate, poorly defined; escutcheon broadly elliptical, pouting. Margin of shell finely crenulate.

Family Pharidae

***Phaxas pellucidus* (Pennant, 1777)**
Figure 9M

New records. GERMANY – **North Sea** • SAR; 54°40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Shell thin and brittle, elongate; dorsal margin practically straight, ventral margin curved. Anterior end rounded and upturned, posterior slightly truncate. Left valve with a group of three projecting teeth: two cardinals, the posterior being broad and bifid, and posteriorly a single lateral. Right valve with two teeth, a single cardinal and a backwardly directed posterior lateral. Anterior adductor as long as ligament, posterior small and largely fused with the dorsal edge of the irregular pallial sinus.

Family Psammobiidae

***Gari fervensis* (Gmelin, 1791)**
Figure 9N

New records. GERMANY – **North Sea** • SAR; 54° 45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54° 47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • BRG; 53° 59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell thin, elongate, more than twice as long as broad. Umbones anterior to midline; anterior hinge line forming a smooth continuous curve with anterior margin, posterior hinge line sloping more steeply, forming a sharp angle with truncate posterior margin. A distinct keel extends posteriorly from the umbone to postero-ventral corner of each valve. Right valve with two cardinal teeth, the anterior grooved, posterior distinctly bifid; left valve with a large, bifid anterior cardinal, and a slender posterior cardinal. Pallial sinus deep, U-shaped, its lower edge largely fused with the pallial line.

Family Turritellidae

***Turritellinella tricarinata* (Brocchi, 1814)**

New records. GERMANY – **North Sea** • SAR; 54° 40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. As original description of *Turbo tricarinatus* by Brocchi (1814).

Family Semelidae

***Abra prismatica* (Montagu, 1808)**
Figure 9O

New records. GERMANY – **North Sea** • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020; M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell thin and brittle, elongate-oval to fusiform, approximately twice as long as deep. Right valve with two small cardinal teeth anterior to chondrophore, and single anterior and posterior lateral tooth; left valve with one small cardinal tooth and poorly developed single anterior and posterior laterals. Pallial sinus with lower edge partly fused with pallial line.

Family Sepiolidae

***Sepiola atlantica* d'Orbigny, 1842**
Figure 9P

New records. GERMANY – **North Sea** • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl.

Identification. Body is smooth and translucent. Dorsal anterior mantle edge is fused to dorsal surface of head, between eyes; ventral edge of mantle with straight, thickened edge. Fins are thin and delicate, each as broad as body at point of attachment, irregularly rounded.

Family Veneridae

***Chamelea striatula* (da Costa, 1778)**
Figure 9Q

New records. GERMANY – **North Sea** • 1 SAR; 54°40.10′N, 006°38.45′E; 39.4 m dp.; 09.V.2020 • SAR; 54°44.12′N, 006°49.76′E; 41.2 m dp.; 09.V.2020 • SAR; 54°45.38′N, 006°43.21′E; 41.8 m dp.; 09.V.2020 • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°49.06′N, 006°43.97′E; 44 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°49.51′N, 006°37.69′E; 42.5 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°52.95′N, 006°39.86′E; 44 m dp.; 10.V.2020 • SAR; 54°51.54′N, 006°35.44′E; 43 m dp.; 10.V.2020 • SAR; 54°54.63′N, 006°38.09′E; 44 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • SAR; 55°12.91′N, 006°12.23′E; 49.4 m dp.; 13.V.2020 • SAR; 55°03.11′N, 006°07.37′E; 45.3 m dp.; 13.V.2020 • SAR; 54°59.90′N, 005°56.77′E; 40 m dp; 13.V.2020 • SAR; 54°41.83′N, 006°49.71′E; 41 m dp.; 14.V.2020 • SAR; 54°38.75′N, 006°54.35′E; 40 m dp.; 14.V.2020 • SAR; 54°33.46′N, 007°00.54′E; 37 m dp.; 14.V.2020 • BRG; 53°59.98′N, 006°15.92′E; 32.5 m dp. 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020 • BRG; 53°59.93′N, 006°19.79′E; 29 m dp.; 01.VII.2020 • BRG; 53°58.12′N, 006°19.17′E; 29.4 m dp.; 01.VII.2020 • BRG; 53°58.03′N, 006°18.14′E; 30 m dp.; 01.VII.2020 • BRG; 53°56.94′N, 006°18.88′E; 30.1 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Dirty white, cream, or pale yellow. Usually with three red-brown rays of varying width, radiating from the umbones. Periostracum thin.

***Dosinia exoleta* (Linnaeus, 1758)**
Figure 9R

New records. GERMANY – North Sea • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.00′N, 006°17.55′E; 29.8 m dp.; 02.VII.2020 • BRG; 53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. Shell is solid, thick, equivalve and broadly triangular in outline with a round anterior margin but tending to be slightly drawn out posteriorly. Lunule is short, heart-shaped, light brown with fine radiating ridges. Three cardinal teeth in each valve and no laterals. Pallial sinus is not deep. Inner margin is crenulate from below the beak forward to the posterior margin of the escutcheon.

***Dosinia lupinus* (Linnaeus, 1758)**
Figure 9S

New records. GERMANY – **North Sea** • SAR; 54°47.82′N, 006°46.25′E; 43.8 m dp.; 09.V.2020 • SAR; 54°47.50′N, 006°40.45′E; 42.1 m dp.; 09.V.2020 • SAR; 54°51.21′N, 006°41.86′E; 43.5 m dp.; 10.V.2020 • SAR; 54°53.28′N, 006°32.76′E; 43 m dp.; 13.V.2020 • SAR; 54°59.70′N, 006°40.32′E; 42.5 m dp.; 13.V.2020 • BRG; 54°00.09′N, 006°13.91′E; 32.2 m dp.; 01.VII.2020 • BRG; 54°00.05′N, 006°18.11′E; 30 m dp.; 01.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; beam trawl and ring dredge.

Identification. As original description of *Venus lupinus* by Linnaeus (1758).

***Polititapes rhomboides* (Pennant, 1777)**
Figure 9T

New records. GERMANY – **North Sea** • BRG; 53°57.59′N, 006°15.27′E; 30.2 m dp.; 01.VII.2020 • BRG; 53°57.15′N, 006°15.80′E; 29.5 m dp.; 02.VII.2020 • BRG;

53°54.90′N; 006°15.09′E, 31.7 m dp.; 02.VII.2020 • BRG; 53°54.89′N, 006°17.14′E; 29 m dp.; 02.VII.2020 • BRG; 53°54.94′N, 006°18.98′E; 28.5 m dp.; 02.VII.2020 • BRG; 53°56.02′N, 006°18.06′E; 29 m dp.; 02.VII.2020; all localities: M. Sonnewald and L. Lehnhoff leg.; ring dredge.

Identification. Shell elongate, oval to quadrate, umbones distinctly anterior; hinge line sloping anteriorly, straight posteriorly, forming a sharp angle with posterior margin. Each valve with three cardinal teeth: centre one of left valve, and centre and posterior of right are bifid. Adductor scars and pallial line distinct. Pallial sinus deep and U-shaped.

Analyses of the species composition at SAR and BRG. Sampling of the two study areas in the North Sea revealed 61 species at SAR and 62 species at BRG, while 9 species at SAR and 10 species at BRG remained undetermined because of the lack of taxonomic experts, mainly Cnidaria. These were excluded from the following analyses. In both study areas, the phylum Chordata (SAR: 26.6%, BRG: 30.6%), Mollusca (SAR: 24.6%, BRG: 29%) and Arthropoda (SAR: 19.7%, BRG: 21.0%) account for the largest proportion of the abundances of different species (Fig. 10). Bryozoa accounted for the smallest proportion of phyla occurring in both areas (SAR: 1.6%, BRG: 1.6%). Of the determined Cnidaria, species only occurred in SAR (4.9%), none in BRG.

A Bray-Curtis similarity analysis of the two study areas showed clear delineation of species composition. The stress level of the multidimensional scaling is 0.07, which is below the 0.1 mark indicating greater conformity. An analysis for differentiation of species composition in the two study areas using multivariate statistics (*adonis*) revealed a significant influence of the factor "area" on the species composition of the epifauna ($p = 0.001$).

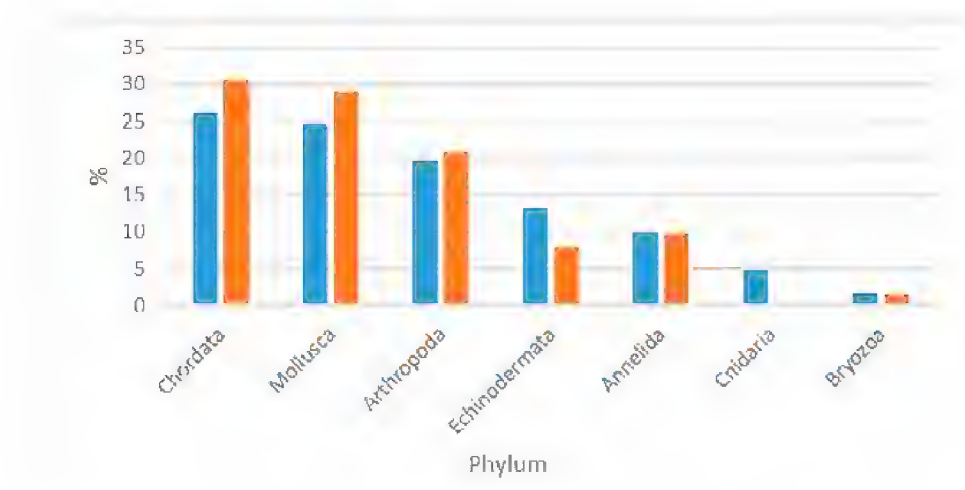


Figure 10. Percentage of species per phylum at SAR and BRG.

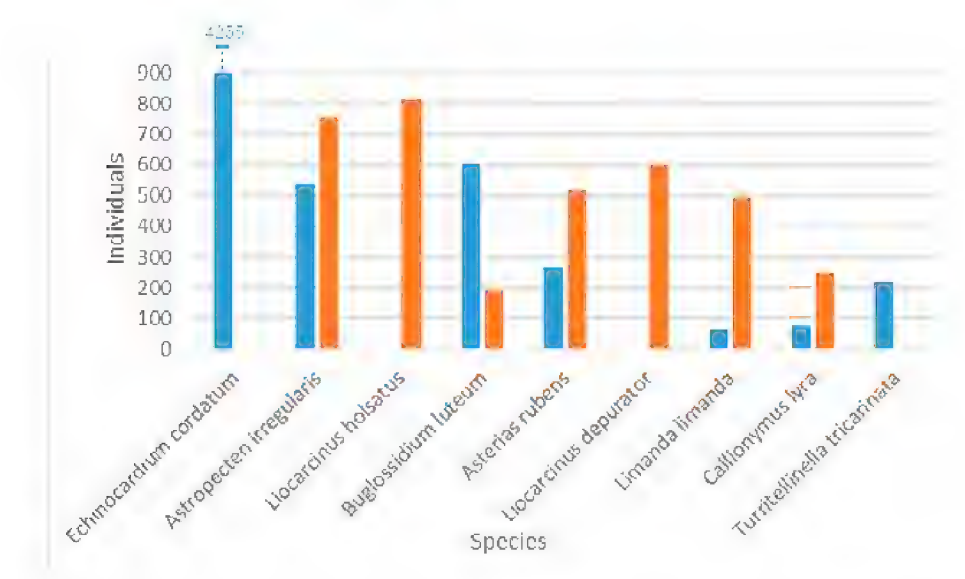


Figure 11. Number of individuals per species, which were found most common with a number of individuals >1000.

A Shannon-Wiener (Hs) comparison of diversity showed higher mean index values at BRG (mean Hs = 2.0) compared to SAR (mean Hs = 1.4). Using the presence/absence data collected by the ring dredge, a Jaccard index of 0.33 could be determined, which represents a comparatively low species overlap of 33% between the two areas.

Nevertheless, 12 species overlap in the two areas. The largest number of individuals occurring in both areas is found in the species *Asterias rubens*, *Astropecten irregularis*, and *Buglossidium luteum*. On the other hand, *Liocarcinus holsatus* and *Liocarcinus depurator* were only found at BRG in high numbers of individuals (Fig. 11). *Echinocardium cordatum* was found with the highest abundance with 4255 individuals, but only at SAR (Fig.11).

Discussion

Diversity and abundance. We present an annotated list of species sampled in 2020 in two nature protection sites of the North Sea, SAR and BRG. While the general species composition seems relatively similar, the epifauna of BRG shows a higher diversity. According Schulze (2018), the SAR is exposed to higher fishing pressure from German vessels engaged in trawling (Fig. 12), which has a proven influence on the diversity of the fauna found there (de Groot 1984; Zühlke et al. 2001) and could be an explanation for the fact that in the SAR the epifauna diversity is lower in comparison. However, this should be compared in further studies with more study sites to make a statistically valid statement. The North Sea is one of the most biologically productive ecosystems in the world (Kirby et al. 2007) but is also considered one of the world's most important shelf seas in terms of fisheries (Couce et al. 2020). As benthic macrofauna plays a key role in the function of marine ecosystems (Shojaei et al. 2016), protection and conservation of epifauna biodiversity is desirable.

The sediment as habitat and the food web of demersal fishes and invertebrate and epifauna can be disrupted by an anthropogenic impact such as fishing (Eggleton et al. 2018), which overall represents a serious disturbance to benthic habitats (Rijnsdorp et al. 2018). Beam trawl fisheries can also be seen to homogenize surface sediments, which can result in a strong negative impact on the abundance of epibenthic species (Tiano et al. 2020). A more indirect effect of fishing on the food system is the increased feeding on predators that benefit from dead bycatch (Ruhmor and Kujawski 2000) and benthic invertebrates (Hiddink et al. 2008), discarded back to the sea. The Bray-Curtis similarity analysis showed that the species composition of the two study areas can be clearly separated. This means that even within the North Sea

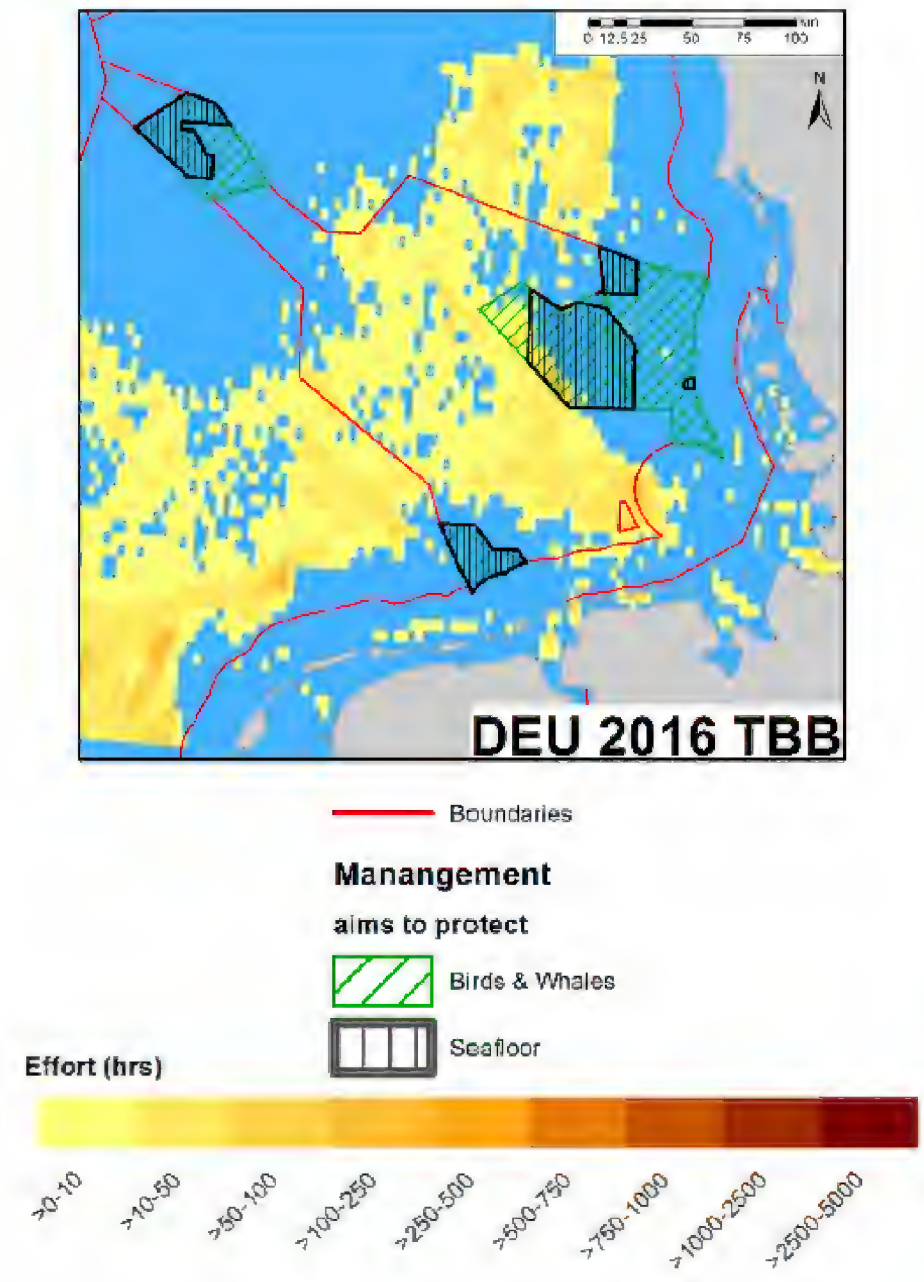


Figure 12. Beam trawl effort of German vessels in 2016 in the North Sea. Adapted from Schulze (2018).

clear differences in biodiversity are to be expected, documenting that regional protection is sensible and necessary in order to be able to preserve individual species of epifauna in the North Sea. Within the SAR, biodiversity in the focus area (Fig. 1B) is relatively similar, also suggesting regional species communities. In the context of other influencing factors such as increasing water temperature (Shojaei et al. 2016), ocean acidification (Wood et al. 2010) or influence of offshore wind farms (Causon and Gill 2018) on benthic communities, species could be weakened, being more vulnerable to mobile bottom trawling. The negative effect of beam trawling on benthic macrofauna in the North Sea is not an unknown problem. In a study by Bergman and Hup (1992), it was already shown that the sediment is sifted up to 6 cm deep by the beam trawls, which had direct effects on the abundances of the fauna living there. Beside the known problems caused by such fishery vessels, small vessels without logbook data are a problem for the recording of fishing trips in the North Sea in order to be able to estimate the actual influences (Scientific, Technical and Economic Committee for Fisheries 2020).

An epibenthos sampling list of the North Sea from 1999 showed matches of the species found during the present study, such as *Asterias rubens*, *Aphrodita aculeata*, or *Crangon allmanni* (Zühlke et al. 2001). Species being very typical at the study areas (Rees et al. 1999) were detected in this study in 2020, such as *Liocarcinus navigator* in the BRG. In the SAR, the angular crab *Goneplax rhomboides* was found at two nearby stations. This species is typically native to the northeastern Atlantic and Mediterranean Sea and has only been found in the North Sea since 2000 (Neumann et al. 2013). This is obviously caused by an increase in water temperature as a result of climate change (Neumann et al. 2013).

Some of the species with the highest abundance, such as the common starfish *Asterias rubens*, co-exist with other species not reliably detectable by beam trawls, such as *Mytilus edulis* (Saier 2001). If the abundance of sea stars is reduced by beam trawling, this may also affect their prey and energy flows of entire food webs could shift (Hahn 2020). *Echinocardium cordatum* was found in the highest number of individuals, which corresponds to the natural habitat of *E. cordatum* in the relatively shallow and sandy study area (Buchanan 1966). The high number of *E. cordatum* in the Sylt Outer Reef reflects previous suggestions that it is one of the most widespread echinoids (De Ridder and Saucède 2020). However, this is contradicted by the fact that *E. cordatum* was not found at all in the BRG study area. *Echinocardium cordatum* plays a significant role in sediment mixing with seawater, especially at high individual densities (Sandnes et al. 2000), which promotes recycling of organic matter in the sediment (De Ridder and Saucède 2020). Again, impact by bottom-touching fisheries that would affect *E. cordatum* would be disruptive to ecosystem conservation.

A recent study of the current status of the epifauna in the SAR and BRG showed that a considerable diversity of benthic organisms as well as a distinct footprint of species composition and abundance allowing to separate the two areas BRG and SAR is present. However, this study only describes the status from the year 2020, changes in the last decades thus cannot be mapped because of a lack of past data. In addition, there is only a comparison between two areas in the North Sea, and for more meaningful statements, the highest possible coverage of the North Sea would have to be included in the analysis. This can be achieved by combining field, experimental, and modelling data. This has already shown that bottom trawling does have an effect on ecosystem functionality (Olsgard et al. 2008). A further step would be the continuous adjustment of existing model analyses regarding the influence of bottom trawling (Piet et al. 2009). The establishment of marine protected areas is a first step to protect the biotic communities of the North Sea (Hiddink et al. 2008); based on further studies, the exclusion of mobile, bottom-contact fishing in the protected areas could then be recommended. In order to differentiate the fishery factor from other factors influencing epifaunal diversity in future studies, methods such as random forest can be applied (Parravicini et al. 2012; Denisko and Hoffman 2018). With the help of principal component analyses, different parameters can be analysed with the biodiversity data, and the strength of their influence can be worked out (Abdi and Williams 2010).

Conclusion. In a future publication, collected datasets of the epifauna of the North Sea will be compared with historical datasets. In addition, the NATURA 2000 site Dogger Bank will be included in the evaluation. Changes in epifaunal communities in the study areas have to be worked out more clearly. The data will be correlated with various biotic and abiotic parameters to be able to name influences on change more clearly. Modeling of the distribution of species based on the last 20 years and an analysis of changes in the proportion of endangered species will also be carried out in order to predict whether the protected status of the areas provides sufficient protection for the bottom-trawling fauna. The influence of the increasing fishing pressure by mobile bottom trawling will be investigated in order to be able to make a prognosis on the expected further increase of fishing pressure in the North Sea. Identification of threat levels this can be used as a measure of species community disturbance (Thrush and Dayton 2002; Moullec et al. 2021). It would also be interesting to compare the epifauna of the North Sea and the Baltic Sea, as differences in biodiversity and fishing effort are likely between these seas.

Authors' Contributions

Conceptualization: SJH. Data curation: SJH. Formal analysis: SJH. Funding acquisition: AB. Project administration: AB. Supervision: AB, MS. Visualization: SJH. Writing – original draft: SJH. Writing – review and editing: MS, SJH, AB.

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Appendix

Table A1. Start and end coordinates of sampling (beam trawl) in the SAR and BRG areas with the station name, date and time of sampling, averaged abiotic water parameters, and water depth when the beam trawl was lowered and raised.

Station	Date	Time (h)	Event	Geographic coordinates	Depth (m)	Temperature (°C)	Salinity (psu)
SAR							
SAR20-01	09.V.2020	08:27	On ground	54°40.10′N, 006°38.45′E	39.4	8.5	34.1
SAR20-01	09.V.2020	08:58	Off ground	54°39.19′N, 006°39.20′E	39.8	8.5	34.1
SAR20-02	09.V.2020	10:27	On ground	54°44.12′N, 006°49.76′E	41.2	8.4	34.0
SAR20-02	09.V.2020	10:57	Off ground	54°45.38′N, 006°43.21′E	41	8.4	34.0
SAR20-03	09.V.2020	12:11	On ground	54°45.38′N, 006°43.21′E	41.8	8.4	34.1
SAR20-03	09.V.2020	12:39	Off ground	54°45.36′N, 006°41.48′E	41.6	8.4	34.1
SAR20-04	09.V.2020	13:49	On ground	54°47.82′N, 006°46.25′E	43.8	8.3	34.1
SAR20-04	09.V.2020	14:14	Off ground	54°46.79′N, 006°46.35′E	42.8	8.3	34.1
SAR20-05	09.V.2020	15:08	On ground	54°49.06′N, 006°43.97′E	44	8.3	34.2
SAR20-05	09.V.2020	15:35	Off ground	54°49.95′N, 006°44.94′E	44.8	8.3	34.2
SAR20-06	09.V.2020	16:37	On ground	54°47.50′N, 006°40.45′E	42.1	8.5	34.3
SAR20-06	09.V.2020	17:02	Off ground	54°47.68′N, 006°42.22′E	42.3	8.5	34.3
SAR20-07	09.V.2020	18:08	On ground	54°49.51′N, 006°37.69′E	42.5	8.4	34.3
SAR20-07	09.V.2020	18:35	Off ground	54°49.79′N, 006°39.37′E	42.2	8.4	34.3
SAR20-08	10.V.2020	07:33	On ground	54°51.21′N, 006°41.86′E	43.5	8.5	34.1
SAR20-08	10.V.2020	08:00	Off ground	54°51.07′N, 006°40.18′E	43	8.5	34.1
SAR20-09	10.V.2020	08:52	On ground	54°52.95′N, 006°39.86′E	44	8.7	34.1
SAR20-09	10.V.2020	09:22	Off ground	54°52.99′N, 006°38.12′E	43.5	8.7	34.1
SAR20-10	10.V.2020	10:14	On ground	54°51.54′N, 006°35.44′E	43	8.6	34.3

Station	Date	Time (h)	Event	Geographic coordinates	Depth (m)	Temperature (°C)	Salinity (psu)
SAR20-10	10.V.2020	10:41	Off ground	54°50.56′N, 006°34.99′E	42.6	8.6	34.3
SAR20-11	13.V.2020	08:13	On ground	54°53.28′N, 006°32.76′E	43	8.2	34.3
SAR20-11	13.V.2020	08:40	Off ground	54°54.26′N, 006°32.42′E	43	8.2	34.3
SAR20-12	13.V.2020	09:48	On ground	54°54.63′N, 006°38.09′E	44	8.1	34.3
SAR20-12	13.V.2020	10:16	Off ground	54°55.44′N, 006°37.05′E	44.3	8.1	34.3
SAR20-13	13.V.2020	11:29	On ground	54°59.70′N, 006°40.32′E	42.5	8.3	34.1
SAR20-13	13.V.2020	11:58	Off ground	55°00.29′N, 006°38.88′E	43.1	8.3	34.1
SAR20-14	13.V.2020	15:15	On ground	55°12.91′N, 006°12.23′E	49.4	7.9	34.6
SAR20-14	13.V.2020	15:45	Off ground	55°13.79′N, 006°11.19′E	49.3	7.9	34.6
SAR20-15	13.V.2020	17:44	On ground	55°03.11′N, 006°07.37′E	45.3	8.4	34.6
SAR20-15	13.V.2020	18:06	Off ground	55°03.81′N, 006°06.15′E	44.7	8.4	34.6
SAR20-16	13.V.2020	19:34	On ground	54°59.90′N, 005°56.77′E	40	8.7	34.7
SAR20-16	13.V.2020	20:00	Off ground	55°00.43′N, 005°55.56′E	40	8.7	34.7
SAR20-17	14.V.2020	07:33	On ground	54°41.83′N, 006°49.71′E	41	8.4	33.9
SAR20-17	14.V.2020	08:05	Off ground	54°42.12′N, 006°47.92′E	40	8.4	33.9
SAR20-18	14.V.2020	09:29	On ground	54°38.75′N, 006°54.35′E	40	8.4	33.8
SAR20-18	14.V.2020	09:59	Off ground	54°39.43′N, 006°53.03′E	40	8.4	33.8
SAR20-19	14.V.2020	11:34	On ground	54°33.46′N, 007°00.54′E	37	8.6	33.5
SAR20-19	14.V.2020	12:06	Off ground	54°33.57′N, 006°59.03′E	38	8.6	33.5
BRG							
BRG20-01	01.VII.2020	07:29	On ground	54°00.09′N, 006°13.91′E	32.2	15.7	33.4
BRG20-01	01.VII.2020	07:57	Off ground	53°59.18′N, 006°13.91′E	31.2	15.7	33.4
BRG20-02	01.VII.2020	09:59	On ground	53°59.98′N, 006°15.92′E	32.5	15.7	33.3
BRG20-02	01.VII.2020	10:23	Off ground	53°58.99′N, 006°15.77′E	30.5	15.7	33.3
BRG20-03	01.VII.2020	11:41	On ground	54°00.05′N, 006°18.11′E	30	15.6	33.4
BRG20-03	01.VII.2020	12:14	Off ground	54°00.35′N, 006°19.84′E	30	15.6	33.4
BRG20-04	01.VII.2020	13:33	On ground	53°59.93′N, 006°19.79′E	29	15.7	33.4
BRG20-04	01.VII.2020	13:58	Off ground	54°00.22′N, 006°21.34′E	28.1	15.7	33.4
BRG20-05	01.VII.2020	15:21	On ground	53°58.12′N, 006°19.17′E	29.4	15.9	33.3
BRG20-05	01.VII.2020	15:44	Off ground	53°57.72′N, 006°20.80′E	30.6	15.9	33.3
BRG20-06	01.VII.2020	16:59	On ground	53°58.03′N, 006°18.14′E	30	15.9	33.3
BRG20-06	01.VII.2020	17:29	Off ground	53°57.58′N, 006°16.73′E	29.7	15.9	33.3
BRG20-07	01.VII.2020	18:48	On ground	53°58.11′N, 006°16.91′E	30.2	15.8	33.3
BRG20-07	01.VII.2020	19:20	Off ground	53°57.59′N, 006°15.27′E	30.2	15.8	33.3
BRG20-08	02.VII.2020	07:06	On ground	53°57.15′N, 006°15.80′E	29.5	16.0	33.2
BRG20-08	02.VII.2020	07:24	Off ground	53°56.96′N, 006°14.15′E	30	16.0	33.2
BRG20-09	02.VII.2020	09:09	On ground	53°57.00′N, 006°17.55′E	29.8	16.0	33.2
BRG20-09	02.VII.2020	09:36	Off ground	53°56.80′N, 006°15.84′E	29.7	16.0	33.2
BRG20-10	02.VII.2020	11:34	On ground	53°56.94′N, 006°18.88′E	30.1	16.1	33.2
BRG20-10	02.VII.2020	11:58	Off ground	53°56.32′N, 006°20.24′E	29.9	16.1	33.2
BRG20-11	02.VII.2020	14:02	On ground	53°54.90′N, 006°15.09′E	31.7	16.0	33.3
BRG20-11	02.VII.2020	14:13	Off ground	53°55.10′N, 006°14.52′E	32.4	16.0	33.3
BRG20-12	02.VII.2020	15:34	On ground	53°54.89′N, 006°17.14′E	29	16.2	33.2
BRG20-12	02.VII.2020	15:58	Off ground	53°55.55′N, 006°15.88′E	29.6	16.2	33.2
BRG20-13	02.VII.2020	17:14	On ground	53°54.94′N, 006°18.98′E	28.5	16.2	33.2
BRG20-13	02.VII.2020	17:38	Off ground	53°54.29′N, 006°17.54′E	31	16.2	33.2
BRG20-14	02.VII.2020	18:41	On ground	53°56.02′N, 006°18.06′E	29	16.1	33.2
BRG20-14	02.VII.2020	19:07	Off ground	53°55.08′N, 006°17.36′E	29	16.1	33.2